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Dark Green.

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FREESIA, *KLATT*, AND ITS HISTORY.

By N. E. Brown, D.Sc., A.L.S.

This charming genus of *Iridaceae* has long been familiar to horticulturists and valued by them for the beauty and fragrance of its flowers, and many beautiful hybrid forms have been produced in our gardens. Yet, apart from a few notes and descriptions of new species, no history of the genus nor proper descriptive account of its species has hitherto been published.

Personally the writer has previously had contact with this genus on three occasions only, and each time recognised that to properly deal with any new form the whole genus first required a thorough examination and revision (as is the case with most genera of *Iridaceae*), for which time could not then be spared and so mistakes were made. For *Freesia* has proved a stumbling block to every botanist that has had anything to do with it, from Klatt, who founded the genus, to and including living authors of the present time. And it is a curious fact that, while horticulturists in the main have clearly recognised as distinct and have correctly named the plants they cultivated, botanists (myself included) have not escaped the making of gross misidentifications, because the characteristics of the species have not been heeded. It was not until I began to study the genus in July, 1933, that I became fully aware of the confusion in which the species were becoming enmeshed, and which caused me to make an investigation of all available material and collect such published information as I could find, the following account being the result.

As recognised to-day the genus *Freesia* was established by Klatt in 1866 in *Linnaea*, v. xxxiv, p. 672, as "*Freesia*, Ecklon," because Ecklon had distributed a species under the unpublished name of "*Freesia odorata*, Ecklon," which Klatt there described under that name. But Ecklon has nowhere published characters of a genus to which that plant could be referred. Ecklon, however, did publish in 1827, in his *Topographisches Verzeichniss*, p. 30, a genus named "*Freesea*, Eckl." but did not characterise it, except by a very imperfect description of a plant he named "*F. miniato-lateritia*, Eckl.", which is the well-known *Tritonia*

miniata, Ker. With this Ecklon associates three other species of *Tritonia* and an *Ixia*. Therefore *Freesea* of Ecklon as a genus vanishes, for it never had the slightest claim to be recognised, and the generic name *Freesia* with its modified spelling is correctly attributed to Klatt. It is stated in some books that the derivation of the name is unknown, but Prof. L. Diels, Director of Berlin Herbarium, informs me that Ecklon named the genus *Freesea* after his college companion and friend, Dr. Friedrich Heinrich Theodor Freese, who was a physician at Kiel, where he died on Aug. 26th, 1876. This corroborates the similar statement made by Marloth in his *Flora of S. Africa*, v. iv, p. 150.

From the above the modified spelling *Freesia* adopted by Klatt must evidently be considered to have the same derivation.

Klatt recognised four species and one variety, viz., *F. odorata*, *F. Leichtlinii*, *F. xanthospila* and *F. refracta* and its variety *alba* ; and Prof. Michael Foster recognised the same, but gave the name *F. alba* to the plant Klatt described as *F. refracta alba*, overlooking the fact that the specific name *F. lactea*, Fenzl, had already been quoted for it as a synonym by Klatt. Baker in *Flora Capensis*, v. vi, and elsewhere considered these five to be mere varieties of one species, besides including with them some other distinct species which were not then named. And Marloth in his *Flora of S. Africa*, v. iv, p. 150, also adopts the view that there is only one variable species belonging to the genus. Some of the species certainly do bear a superficial resemblance to one another ; especially is this the case with dried specimens, causing botanists to make misidentifications. This happened because the real characters that distinguish the species were overlooked and unrecorded until 1888, when Prof. Michael Foster made use of some of them, but the distinctions were either overlooked or not made use of by Baker or others until 1927, when Mrs. L. Bolus began to make use of them. Therefore we find that in various herbaria Klatt has named and autographed the name in each case no less than four perfectly distinct species as being "*F. refracta*" ! And from quotations given under *F. lactea* and *F. xanthospila*, var. *Leichtlinii* it will be noted that Prof. MacOwan failed to distinguish various species from one another when alive ! So that it is not to be wondered at that both botanists and horticulturists have been baffled and confusion has resulted, which it is hoped the following account may tend to elucidate. For I have had the privilege of being able to examine and simultaneously compare the type specimens of Burmann in the Geneva herbarium, of Klatt in Berlin and Vienna herbaria, and the material in the Kew, British Museum, Cambridge, Zurich, Cape Town, Albany and Pretoria herbaria, for which I thank and greatly appreciate the courtesy accorded to me by the respective Directors of those institutions.

Of the species now placed in the genus *Freesia* the first that were discovered appear to be *F. corymbosa* and *F. caryophyllacea*, both of which occur in Burmann's herbarium, now at Geneva, and according to a note with the specimen, *F. caryophyllacea* was described from bulbs introduced from the Cape into Europe, where they flowered in 1759 and the description was published in 1768 under the name of *Ixia caryophyllacea*.

F. corymbosa is a change of name for the plant described by Klatt as *F. odorata* and widely named in herbaria as being *F. refracta*, which does not appear to have been introduced into Europe until about 1831, while Burmann's specimen is probably of Cape origin and dates from before 1768, when Burmann described it under the name of *Gladiolus corymbosus*, indicating that he did not consider it to belong to the same genus as *F. caryophyllacea*.

Eight years later, in 1786, *F. refracta* was published by Jacquin under the name of *Gladiolus refractus*, but its discoverer and locality are not mentioned.

No further addition to the genus was made until 1807, when *F. xanthospila* was published as being a *Gladiolus*. And in 1812 Burchell collected *F. Andersoniae* in Bechuanaland, but it has only recently been named.

In 1814 *F. Sparrmannii* was added, being described as a *Gladiolus* by Thunberg, who received it from Sparrmann.

Probably many will be surprised to learn that the beautiful pink-flowered *F. Armstrongi*, which is considered to be a somewhat modern discovery, was really discovered over 100 years ago by the Kew collector Bowie, who sent bulbs to Kew Gardens, where it flowered, and an excellent coloured drawing of it was made by Bond, a Kew artist, on May 19 1826 !

From that time onward it is probable that occasional specimens of the genus appeared in European gardens, but it was not until after the publication of *F. Leichtlinii* in 1874 that the genus began to attract the fancy of horticulturists, and the cultivation of Freesias became more general. For, on account of their free flowering habit, decorative character and the fragrance of their flowers, they speedily attracted attention, and the inevitable production of hybrids resulted, especially during the first two decades of this century, during which a large number of hybrid variations have been created, references to some of which will be given later.

But, as this account of the species will demonstrate, the possible production of new types of hybrids is by no means limited to the few species at present cultivated in Europe, as there are several others of which horticulturists in Europe appear to have no knowledge, and

probably there are others still awaiting discovery, as the genus appears to be spread over a large part of S. Africa, extending from the south coast far into the interior and reaching Bechuanaland, where *F. Andersoniae* occurs, and ranges from there through all the divisions along the Orange River eastward to the Orange Free State and southward to Carnarvon and Graaff Reinet divisions, this species having the widest range of all at present known. *F. corymbosa* ranges from Humansdorp through Uitenhage, Bathurst and Albany divisions. Most of the other species appear to be concentrated in the south coastal area extending from Caledon to Humansdorp division, and within that region the species appear to be somewhat local or to inhabit a comparatively small area. Also there are species that extend the range of the genus westward, which occur in Malmesbury, Worcester, Van Rhynsdorp and Ceres divisions.

During the early period of the adoption of this genus by horticulturists various accounts of its cultivation appeared in gardening papers, of which those given in the *Gardeners Chronicle*, 1888, v. iii, pp. 52, 83, 107, 119, 152, 182, 235 and 649 appear to be about the best and are all in one volume, and will suffice to give instruction, as all the information required will be found in them. And in *Journ. Soc. Hort. France*, 1891, pp. 152 and 215, P. Duchartre gives a full account of the mode of growth of this genus, well illustrated by figures on pp. 159, 222 and 226. As the method of cultivation and mode of growth of this genus is now well known to horticulturists it is unnecessary to repeat them here.

In S. Africa Freesias appear to have but one flowering period, but a writer in the *Gard. Chron.*, 1889, v. iv, p. 407, states that under cultivation, in suitable localities, "they may be had in bloom from bulbs nearly the whole year round."

As previously mentioned, the characters that distinguish the species from one another appear first to have been made use of by Prof. Michael Foster in *Gard. Chron.*, 1888, v. iii, p. 588, and on p. 589 he calls attention to the fact that different species differ in their odour.

The distinctive characters these plants possess and which I have used in the following key and descriptions are :—

1. The outer bracts of the flowers (always termed bracts in the key and descriptions, as the inner bracts are of no specific importance except in *F. Andersoniae*, where they are longer than the outer bracts), are green in some species, with or without narrow membranous edges, and in others they are membranous, at least in the upper half. This character of green or membranous bracts is constant for each species and serves to divide the genus into two groups. In the case of dried specimens, however, unless one has acquired a little experience it is sometimes a

little difficult to be sure if the bracts were green or membranous when alive. Yet on the living plant the difference is very obvious.

2. The three inner lobes of the flower in some species are more or less cordate or ear-lobed at the base, and the ear-lobed margins are incurved. In other species the inner three lobes are either rounded into or slightly and gradually narrowed at the base. This character of the form of the inner lobes of the flower is also constant for each species, is easily seen and, again, serves to divide the species into two groups.

3. The size of the flower varies to some extent in the same species, but on the whole is a fairly constant character. The form of the flower is constant, and the relative length of the slender part of the tube is also fairly constant for each species.

4. The leaves of most species are ascending ; in some, however, they are bent down towards the ground, and this character is constant for each species. The length, breadth and obtuseness of the leaves, which in some species appear to be constant and reliable characters are inconstant in others, and under cultivation sometimes become changed. Even in S. Africa, where under natural conditions and fully exposed to the sun the leaves of a species are only 4-6 inches long, become 1-1¼ foot long under cultivation or when growing among other vegetation.

In this account the term leaves implies the blades of the leaves only and does not include their sheaths ; and in common with those of many other *Iridaceae* they are often gradually or somewhat abruptly broadened above their base by an increase in width along the upper edge, and the midrib at that part is often more or less curved. This also is a specific character that appears to be fairly constant.

5. The stem is constantly simple in some species and usually branched in others, but this cannot be used as a constant character because a weak plant of a normally branched species may have a simple stem.

Certain species have the stem or lower part of it sprinkled with microscopic points, which are scarcely evident to the naked eye, but are somewhat rough to the touch. Such stems have been described by a South African botanist as pubescent. And morphologically these points are hairs, but I do not think the gardener or even most botanists would recognise them as constituting pubescence as generally understood. I have, therefore, used the term microscopic points for them as being more definite, except in the case of *F. caryophyllacea*, where they are more hair-like and crowded and more like a pubescence in character. The presence or absence of these microscopic points can scarcely be used as a specific character, at least not in all cases, because different specimens

of the same species and gathered at the same time and place have some stems glabrous and others with microscopic points upon them, and I have seen specimens with two stems to a corm in which one stem is glabrous and the other has microscopic points upon it ! None of the older authors mention any pubescence or microscopic points ; probably they were overlooked, for they are very inconspicuous, but certainly occur on specimens seen by Klatt, Foster and Baker.

6. The colour of the stamens and stigmas may perhaps afford characters for living plants, but cannot be made use of for dried specimens. And the relative length of these organs may or may not be of sexual significance, but seems to have no specific value except in the case of *F. flava*, where the style is protruded far beyond the stamens.

Freesia, Klatt.

Rootstock, a corm with fibrous tunics. Leaves two-ranked, laterally flattened. Stem simple or branched. Spike usually bent at an abrupt angle from the stem or its branches, but occasionally continuous with it, and with the flowers all on the upper side of the spike. Bracts two to each flower, small. Flower resupinated (inverted), 6-lobed, with a distinct and usually curved tube, funnel-shaped at the upper part and abruptly or gradually narrowed downwards into a slender part ; lobes either all similar and slightly and gradually narrowed to the base, or the three inner dissimilar from the outer and either rounded in or cordate or earlobed at the base. Stamens 3 ; anthers linear, never reaching to the tips of the upper lobes of the flower. Style equalling or longer than the stamens. Stigmas 6, the style-branches being deeply bifid, usually not attaining to the tip of the upper lobe, but in one species exceeding it and occasionally by the spread of the lobes appearing much exserted. Capsule subglobose, 3-celled, with loculicidal dehiscence. Seeds not seen, described as subglobose, apparently few in each cell.—Klatt in *Linnaea*, v. xxxiv., p. 672 (1866).

Species 19 or more, all natives of South Africa.

For origin of generic name see p. 2.

This genus is easily recognised by its six stigmas and the manner in which the flower-spikes are usually bent at an angle from the stem, with the flowers arranged in a row along the upper side. Also in this genus the flowers are inverted or upside down ; the lobes that in the descriptions are termed lower lobes being uppermost in position on the spike, as they are turned towards the apex of the spike, and just the reverse of the flowers of a Gladiolus.

KEY TO THE SPECIES.

[N.B.—The term "bracts" always means the outer bract of each flower, which, except in *F. Andersoniae*, is longer than the inner bract.]

1. Flower with the slender part of the tube 1½ line in diameter in dried specimens and only 2-2½ lines long; lobes obovate, very broadly rounded at the apex; bracts green; leaves shortly acute .. .. .. 9. *Herberti.*

   Flower with the slender part of the tube ½-¾ line in diameter in dried specimens and as figured when alive and 2-16 lines long; lobes all oblong or the inner three ovate or more or less cordate, all obtuse but not very broadly rounded at the apex (to end of key) .. 2.

2. Leaves very obtuse or rounded at the apex .. .. 3.

   Leaves or at least the upper subacute, or shortly and acutely pointed or tapering to an acute point (to end of key) .. .. 6.

3. Bracts membranous, at least at the upper part, and the three inner lobes of the flower cordate or earlobed at the base .. .. 4.

   Bracts green, and all the lobes of the flower slightly and gradually narrowed at the base; leaves (often by an abrupt bend at the base of the stem) all bent towards the ground .. .. 5.

4. Flower 26-28 lines long, its upper lobes light yellow and the lower lobes rich yellow with orange blotches .. 3. *speciosa.*

   Flower 16-17 lines long, its upper lobes pale mauve, and the lower lobes cream-colour marked with orange and with 1-3 brownish lines extending down the orange tube .. .. 4. *occidentalis.*

5. Plant (including flowers) 1½-3 inches high above the ground; leaves ½-1½ inch long, oval to oblong; flower apparently white with yellow markings on the lower lobes .. .. 1. *parva.*

   Plant 5-10 inches high; leaves 1½-4 inches long; flower yellow with orange or golden blotches on the lower lobes .. .. 2. *Fergusoniae.*

6. Leaves more or less acute; bracts or their upper part membranous, often with dark brown tips .. .. 7.

   Leaves more or less acute; bracts green, with or without narrow membranous edges; inner lobes of flower not cordate nor ear-lobed at the base, but either slightly and gradually narrowed there or (in *F. Middlemostii*) rounded into the base; style and stigmas shorter than the lobes, but sometimes falsely appearing longer when the lobes spread widely .. .. .. 11.

7. Style exserted far beyond the anthers and as long as or longer than the entire flower, being the only species in which it is so; flower 2-2½ inches long, yellow with an orange blotch on the lower middle lobe .. .. 18. *flava.*

Stylo and its stigmas shorter than the lobes of the flower .. .. 8.

8. Flowers 1¾-2¾ inches long, much curved, whitish or pale yellowish, with the three inner lobes rounded into (but not distinctly cordate or ear-lobed at) the base, sometimes on one side only .. .. 19. *Andersoniae.*

Flowers 1-1½ inch long, with the three inner lobes more or less cordate or ear-lobed at the base .. .. 9.

9. Flower with all its lobes rosy pink .. .. 8. *Armstrongi.*

Flower with its upper lobes yellow or dingy greenish yellow and the lower lobes blotched with orange or fulvous .. .. 10.

10. Bracts with dark brown tips; flower pale to intense yellow, with orange-yellow blotches on the lower lobes .. 10. *eorymbosa.*

Bracts not brown at the tips, but sometimes purplish tinted; flower dingy greenish yellow, with fulvous or brownish-yellow blotches on the three lower lobes .. 11. *refracta.*

11. Bracts green; leaves (or those of sun-exposed plants) all bent down towards the ground; flowers white, blotched with orange-yellow on the lower lobes. (See also *C. earyophyllaeea*, whose leaf-pose is unknown.) .. 12.

Bracts green; leaves erect or ascending; lobes of the flower all gradually and slightly narrowed at the base, none ear-lobed (to end of key) .. .. .. 13.

12. Inner lobes of flower rounded into the base .. .. 5. *Middlemostii.*

Inner lobes of flower gradually and slightly narrowed at the base .. .. 6. *elimensis.*

13. Lobes and the slender part of the tube of the flower each about 5 lines long, the entire flower being 1-1¼ inch long; upper lobes white, apparently purplish on the back, and the lower lobes yellow; bracts 2-2½ lines long. 13. *Sparrmannii.*

Lobes of the flowers 6-10 lines long, the entire flower being 1⅓-2⅔ inches long; bracts mostly 3-6 lines long .. .. 14.

14. Flower white, with some v-shaped mauve markings in the tube and the middle lobe of the lower three marked with two yellow spots near the base .. .. 6. *elimensis.*

Flower without v-shaped markings in the tube .. 15.

15. Flowers entirely white without yellow or other markings on the lobes; bracts 4-6 lines long; slender part of the tube 6-8 lines long .. .. 17. *laetea.*

Flowers with yellow blotches on the lower lobes and sometimes flushed with purplish on the back of the upper lobes .. .. 16.

16. Bracts 4-6 lines long; slender part of the flower-tube 5-8 lines long .. .. 17.

Bracts 2-4 lines long; slender part of the flower-tube 2½-5 lines long.. .. .. 18.

17. Leaves 3-5½ lines broad, shortly acute; flowers 2-2½ inches long, apparently white or pale yellow, with the lower middle lobe orange-yellow .. .. 14. *gentilis.*

Leaves $2\frac{1}{2}$-$3\frac{1}{2}$ lines broad, tapering to an acute apex; flowers $1\frac{1}{2}$-2 inches long, apparently with the upper three lobes white or pale sulphur-yellow, flushed with purplish on the back and the lower three yellow .. 15. *picta*.

18. Naked part of the stem between the spike and the uppermost reduced leaf about 1 inch long and densely covered up to the spike with microscopic outstanding points or hairs; leaf 4 inches long and 6 lines broad, gradually tapering from the middle to an acute apex .. 7. *caryophyllacea*.

Naked part of the stem between the spike and the uppermost reduced leaf 2-6 inches or more long, glabrous or sprinkled with microscopic points on the lower part; leaves 3-24 inches long; flowers $1\frac{1}{4}$-2 inches long .. .. 19.

19. Flower with the slender part of the tube $2\frac{1}{2}$-3 (rarely 4) lines long and the lobes 6-7 lines long, white or pale yellow with orange-yellow blotches on the lower lobes; when fading or drying the upper lobes often change to a pale violaceous colour .. .. 12. *Muirii*.

Flower with the slender part of the tube 4-5 lines long and the lobes 7-8 lines long .. .. 20.

20. Flower white with a yellow blotch on the middle one or on all three of the lower lobes .. .. 16. *xanthospila*.

Flower yellow with orange blotches on the lower lobes .. .. 16. *xanthospila* var. *Leichtlinii*.

1. F. PARVA, N. E. Br. Entire plant $1\frac{1}{2}$-3 inches high. Leaves apparently spreading over the ground or bending towards it, perhaps all on one side, $\frac{1}{2}$-$1\frac{1}{2}$ inches long, $2\frac{1}{2}$-6 lines broad, broadened by an abrupt rise of the upper edge, oval to oblong, very obtuse or rounded at the apex, usually apiculate. Stem often bent close to the ground so that the spike is horizontal and including the latter but not the flowers is $\frac{3}{4}$-$2\frac{1}{2}$ inches long, simple or branched and bearing 2-5 flowers, glabrous or sprinkled with microscopic points. Bracts 3-5 lines long, green. Flowers $1\frac{1}{4}$-$1\frac{1}{2}$ inches long, apparently white or creamy inside, sometimes flushed with violaceous or purplish outside, with the middle one of the lower lobes orange shading into yellow at the margins, and the marginal parts of the lateral lobes also yellow; tube 8-10 lines long, abruptly contracted into the slender part, which is 2-3 lines long and not or scarcely exserted from the bracts; lobes 6-9 lines long, the outer $2\frac{1}{2}$-$3\frac{1}{2}$ lines broad, the inner $3\frac{1}{2}$-$4\frac{1}{2}$ lines broad, all oblong, obtuse, slightly and gradually narrowed at the base.

Bredasdorp Div.: near Elim, *Schlechter* 7727!

This is the smallest of all the known species and recognisable at once by its short and broad leaves.

2. F. FERGUSONIAE, L. Bolus in *S. Afr. Gard.*, 1927, pp. 336-337, f. 3-5, and in *Nature Notes*, 1927, no. 50, p. 6, f. 3-5. Plant 5-10 inches

high. Leaves all bent towards the ground, 1½-4 inches long, 4-9 lines broad, oblong to cuneately oblong gradually or abruptly broadening upwards, usually very obtuse. Stem much overtopping the leaves, simple, sprinkled with microscopic points on the lower part. Bracts 2-3 lines long, green. Flowers 1⅓-1⅔ inches long, yellow, sometimes changing to dingy fuscous when dried, with the sides of the three lower lobes dull orange, sometimes changing to dull orange-brown when dried, scented, but not fragrant ; tube 10-12 lines long, abruptly narrowed into the slender part, which is 3-4 lines long ; upper three lobes about 8 lines long and 3½-4 lines broad, with the dorsal or inner one somewhat elliptically obovate, cuneately narrowed to the base and sometimes (always ?) slightly hooded at the apex, and the lateral lobes oblong and gradually narrowed at the base ; lower three lobes 6½-7 lines long and 2-3 lines broad, cuneately obovate ; all the lobes obtuse.

Riversdale Div. : near Riversdale, *Muir* 4352! 4429! 4430! *Ferguson.*

3. F. SPECIOSA, L. Bolus in *S. Afr. Gard.* 1929, p. 385. Plant about 10 inches high. Leaves 3-4 inches long and up to 11 lines broad, with the lower half cuneate and the upper half oblong and very obtuse at the apiculate apex of the only leaf seen. Stem branching. Bracts 4-5 lines long, membranous at the upper part, obtuse or truncate. Flowers 26-28 lines long, with the upper lobes and upper part of the tube light yellow and the lower part of the tube and lower lobes rich yellow with orange blotches on the latter, which each have a purple mid-line ; tube 19-20 lines long, abruptly contracted into the slender part, which is 6-7 lines long ; lobes 7-8 lines long, the three outer 4-4½ lines broad, oblong-ovate ; the three inner 5-7 lines broad and more or less cordate or ear-lobed at the base ; all obtuse.

Swellendam Division : between Bonnievale and Barrydale, *Archer*!

4. F. OCCIDENTALIS, L. Bolus in *S. Afr. Gard.* 1933, p. 255, f. B, and p. 266. Plant 5-7 inches high. Leaves ascending, 2-4¼ inches long, 2½-6 lines broad, sometimes cuneate in general outline, but more often by an abrupt rise of the upper edge below or near the middle the upper part of the leaf is more or less oblong, obtuse or rounded or sometimes slightly hooded at the apex, glaucous-green. Stem about as long as the leaves, simple, glabrous. Bracts 2½-3½ lines long, obtuse, green below, membranous and often purplish above. Flower 12-17 lines long, fragrant ; tube 9-11 lines long, abruptly contracted into the slender part, which is about 2½-3 lines long ; lobes unequal ; the outer about 4½ lines long and 2½-3 lines broad, ovate, obtuse ; the inner about 4-5 lines long and 4½-5 lines broad, broadly cordate or ear-lobed at the base ; the three upper lobes are pale mauve and the three lower cream-coloured, blotched

with rich orange-yellow, and with 1-3 brownish lines on the two inner lobes extending down the orange-yellow tube.

Van Rhynsdorp Div.: near Nieuwefontein, *Compton* 4273!

Described partly from specimens of the type gathering.

5. F. MIDDLEMOSTII, Barker in *S. Afr. Gard.* 1933, p. 112, with fig. Plant 6-8 inches high. Leaves 7-8 to a corm, more or less bent down towards the ground on one side of the plant, 1-5 inches long, 2½-4½ lines broad, linear, acute or somewhat tapering to an acute point, broadening on the upper edge below the middle or towards the base by a small and not very abrupt rise, and the midrib nearly straight at that part. Stem branched, not exceeding the leaves, covered with microscopic points, or very minute stiff, outstanding hairs. Bracts 3-4½ lines long, obtuse, often apiculate, green, with a very narrow, white, membranous edge at the apex. Flowers about 1½ inches long; tube about 1 inch long, with the upper part abruptly contracted into the slender part which is 3-4 lines long; lobes 6-7 lines long and 4½-5 lines broad, all elliptic-ovate, obtuse, rounded into the base from below the middle and the inner three more so than the outer, but not cordate nor carlobed, white within, with orange-yellow blotches on the three lower lobes and at the insertion of the stamens, and suffused with purplish (always ?) on the back of the upper lobes.

Bredasdorp Div.: near Bredasdorp, *Middlemost*!

Described from part of the type gathering. This and *F. elimensis*, L. Bol., are closely allied and may prove to be only varieties of one another.

6. F. ELIMENSIS, L. Bolus in *S. Afr. Gard.*, 1933, pp. 167-168, f. A. Plant 3-12 inches high, very variable in appearance according to whether fully exposed to the sun or growing in shade. Leaves on plants exposed to sun 1¼-3 inches long, 2½-4½ lines broad, varying from oblong to linear-lanceolate, acute or tapering to an acute point rarely (on young plants only) obtuse, sometimes ascending, sometimes bent down towards the ground; on plants growing in shade suberect, 3-6½ inches long, 1½-4½ lines broad, linear, acute; in all the midrib is nearly straight at the basal part, and the increased breadth of the upper edge makes but a small although abrupt rise; deep green. Stem simple or branched and on sun-exposed plants more or less bent to one side from near the base, about equalling the leaves in length, sprinkled with minute points or occasionally glabrous. Spike 2-6-flowered, sometimes bent at an angle from the stem, at others continuous with it. Bracts 3½-5 lines long, obtuse or 3-toothed or rarely acute, green, with very narrow white edges. Flowers 18-22 lines long; tube 10-14 lines long, with the funnel-shaped part abruptly contracted into the slender part, which is 3-6 lines long; lobes 6-9 lines long, 4-4½ lines broad, all alike in form and subequal, very

slightly spreading, oblong, subacute or obtuse, scarcely or but slightly narrowed at the base, white, with a faint pinkish tinge on the outside, usually changing to pale lilac in the process of drying, with the middle lobe of the lower three marked with two yellow spots or a yellow blotch near its base, or sometimes two of the lobes are marked with a yellow blotch ; the two lateral of the lower lobes are each marked on the basal part with 5-7 mauve-coloured lines, the funnel part of the tube bears three V-shaped mauve markings inside, and the part of the tube below the insertion of the stamens is yellow within. Style, stigmas and filaments white ; anthers mauve.

Bredasdorp Div., between Bredasdorp and Elim, *Barker*!

Described partly from living plants sent to Kew by Mrs. L. Bolus, which flowered in November, 1933, and partly from dried material, both from the type gathering.

7. F. CARYOPHYLLACEA, N. E. Br. in *Kew Bull.*, 1929, p. 134. The type specimen consists of one detached developed leaf, one small imperfectly-formed leaf, which may have been an outermost basal one, and a flower-stem. The developed leaf is 4 inches long and 6 lines broad, obliquely lanceolate, tapering to an acute point, with the midrib curved below the middle, where the upper edge of the leaf somewhat abruptly increases in width ; the imperfectly-formed leaf is $2\frac{1}{2}$ inches long and $2\frac{1}{2}$ lines broad at the dilated, linear-spathulate, obtuse apex. Stem apparently exceeding the leaves; pubescent with distinct but very minute hairs, not microscopic points, and bearing one narrow broken stem-leaf, just above which it is abruptly bent sideways and then at a short distance beyond is abruptly curved upwards, ending in a spike $1\frac{1}{2}$ inches long, with evidence of five flowers about 2 lines apart, of which four remain. Bracts 3-$3\frac{1}{2}$ lines long, obtuse or subtruncate at the apex, green. Flowers $1\frac{3}{4}$ inches long, apparently white with a yellow blotch on the lower middle lobe of one flower, while another apparently has the two lateral of the three lower lobes blotched with yellow and the middle lobe white, and all three in all the flowers have a darker midline, but which does not show evidence of having been coloured ; the throat of the tube is yellow, and a faint duskiness about the tips of the lobes of this 174 years old specimen may indicate that when alive they were purplish or lilac-tinted on the back ; tube 9-11 lines long, apparently not curved, funnel-shaped above and abruptly narrowed into the slender part, which is $3\frac{1}{2}$-4 lines long ; lobes 8-10 lines long, 3-$3\frac{1}{2}$ lines broad, subequal, narrowly oblong, all with subparallel sides but slightly narrowed at the base, obtuse.—*Ixia caryophyllacea*, Burmann, *Fl. Cap. Prodr.*, p. 1* (1768), and N. E. Br. in *Kew Bull.*, 1929, p. 134. *Antholyza caryophyllacea*, Roem. and Schultes, *Syst. Veg.*, v. i, p. 448. *Anisanthus caryophyllaceus*, Klatt, *Erganz.* p. 10.

South Africa : locality unknown. Known only from a cultivated specimen in Burmann's Herbarium ! introduced from the Cape, which flowered according to the label in 1759, but according to Burmann's description in 1754.

The above description is made entirely from Burmann's type specimen. The pubescence on the stem extends up to the flower-spike, and although minute and scarcely evident without a lens, is a rather dense pubescence of spreading hairs and quite distinct in character from the microscopic points sprinkled (usually) on the lower part of the stems of some other species.

In *Kew Bulletin* above quoted I have stated that the leaves with the type of *Ixia caryophyllacea* belonged to some species of *Babiana*, because the developed leaf with the specimen does more nearly resemble in shape the leaves of that genus than of any *Freesia* I had then seen. But from species of *Freesia* I have since seen I am sure I was wrong in making that statement. I was also wrong in considering *F. xanthospila* to be the same as *F. caryophyllacea*. I did so because the flowers of the latter seemed quite like those of the former, but now that I have seen the type of *F. xanthospila*, I find they differ in the pubescence of the stem as well as in their foliage.

As Burmann's type specimen of *F. caryophyllacea* is incomplete it is not possible to determine whether its leaves were ascending or all bent towards the ground. The only clues for its identification that can be given are : (1) The rather dense minute pubescence on the stem right up to the base of the spike. (2) The larger leaf with the specimen much resembles in shape the larger of those of the plant figured under the erroneous name of " *F. alba*, Baker " in *S. Afr. Garden.* 1933, p. 111 (concerning which see under *F. lactea*), but whose flowers are totally different. (3) The lobes of the flower are narrowly oblong with sub-parallel sides and of the dimensions mentioned.

8. F. Armstrongi, Watson in *Gard. Chron.* 1898, v. xxiv, p. 195.— Plant 10-15 inches high. Leaves ascending, 2-5 inches long, 3-8 lines broad, linear to linear-lanceolate or oblong-lanceolate or cuneately oblong, subacute to obtuse with an apiculus. Stem exceeding the leaves, branched, glabrous. Bracts 2-3 lines long, membranous at the upper part and more or less purplish-tinted. Flowers 14-17 lines long, bright rosy pink ; tube 9-11 lines long, abruptly contracted into the slender part, which is 3-4 lines long and yellow ; lobes 5-6 lines long, the three outer oblong and 2-3 lines broad, the three inner cordate-ovate and 4-6 lines broad, all obtuse.—*Garden*, 1901, v. lix, p. 374 with fig. ; *Garden Mag.*, 1902, p. 352 ; *Gard. Chron.*, 1904, v. xxxv., p. 149 ; *S. Afr. Gard.*, 1933, p. 111, with fig., and 1929, p. 385. *F. Metelerkampiae*, L. Bol. in

S. Afr. Gard., 1927, p. 336 as to the figure only, not as to the text. *F. brevis*, N. E. Br. in *S. Afr. Gard.*, 1933, p. 263.

Humansdorp Div. : Zuurbron, 700 ft., *Armstrong*! *Fourcade* 3978! Humansdorp, *Drège* 126! near Hankey, *Andrews in Hb. Galpin* 4692! locality unknown, *Bowie* !

Although this beautiful species has only been known to science for about 36 years it was discovered by Bowie over 100 years ago, as evidenced by an excellent coloured drawing of it at Kew, made by Bond (a Kew artist) on May 19th, 1826, from a plant cultivated at Kew which was introduced by Bowie.

F. Armstrongi is the only known species of the genus with wholly pink flowers ; therefore it has been largely used in Europe and America for hybridising and has given origin to a large number of garden hybrids.

With reference to the name *F. Metelerkampiae* quoted above, it may be well to explain that an extraordinary misidentification was made in connection with this plant, for that name was definitely given by Mrs. Bolus to the plant figured in the *Botanical Register* t. 135 as *Tritonia refracta* (see note under *F. refracta*). But the plant figured by Mrs. Bolus as being the same as the plant represented in the *Botanical Register* is manifestly a totally different species. This I pointed out in a note sent to the Editor of *S. Afr. Gardening* in Dec., 1932, and gave the name *F. brevis* to the plant figured. This note, however, was not published until Nov., 1933, although a criticism of it by Mrs. Bolus was published in the issue for May, 1933, p. 111. That note was written several months before I commenced to prepare this account of the genus, and I had not then discovered that the type specimen of the figure mentioned had been seen by Dr. Fourcade and identified by him as being *F. Armstrongi* (see *S. Afr. Gard.* 1929, p. 385), and in my opinion Dr. Fourcade's identification is correct, or rather, as the colour of the flower of the plant Mrs. Bolus has figured is stated to vary " from a greenish yellow with orange and purple to an almost entirely pinkish purple," that it is a garden hybrid derived from *F. Armstrongi*. Its origin is not known, but doubtfully assigned to Robertson Div. without a reason being given.

9. F. HERBERTI, N. E. Br. Plant about 9 inches high. Leaves 4 or 5 to a corm, erect or ascending, 4½-6 inches long, 2-4½ lines broad above the middle, the upper half being sometimes about one-third broader than the lower part by a rather abrupt increase in width of the upper edge, linear, subobtuse. Stem not overtopping the leaves, unbranched, sprinkled on the lower part with microscopic points. Spike of the only specimen seen with two flowers, which are turned in different directions, perhaps in the process of drying. Bracts 2½-3 lines long, very obtuse, apiculate, green. Flowers about 15 lines long ; tube about 9 lines long,

about 5 lines broad at the base of the lobes and abruptly contracted into the slender part, which is 2-2½ lines long and 1½ lines in diameter in the dried flower, and very little longer than the bracts ; lobes 5-6 lines long and 4-5 lines broad, obovate, very broadly rounded at the apex, all narrowed (none earlobed) at the base ; the colour is not determinable, but the lower lobes are blotched with yellow in the usual manner.—*Sparaxis Herberti* of Herbaria ex Klatt in *Linnaea*, v. xxxiv, p. 674, under *Freesia xanthospila*, Klatt.

South Africa : Locality and collector unknown. Cultivated specimen!

Described from a single specimen in Berlin Herbarium labelled "*Sparaxis Herberti*. May 48, H.b.B. Herb Kunth," meaning that it was cultivated in Berlin Botanic Garden under that name and collected by Prof. K. S. Kunth in May, 1848. It is quoted by Klatt as being the same as *F. xanthospila*, Klatt, and is so labelled by him. But it is quite different from that species in foliage and flowers, and differs from that and all other known species by the remarkably stout slender part of the flower-tube, in which character it is quite unique, and the very broadly-rounded tips of the lobes are also different from those of any other known species.

10. F. CORYMBOSA, N. E. Br. in *Kew Bull.* 1929, p. 132. Plant varying from 5-18 inches high according to the supply of moisture. Leaves of flowering plants ascending (but, according to MacOwan in *Gard. Chron.* 1888, v. iii, p. 492, "on first starting the leaves turn over sideways flat to the ground, and do not take the erect position till the scape appears"), 2-6 (or under cultivation up to 16) inches long, 1½-4½ lines broad, linear, tapering to an acute point. Stem exceeding the leaves, usually branched, glabrous. Bracts 2-3 lines long, membranous, with dark brown or blackish tips. Flowers 12-19 lines long, of varying shades of yellow, sometimes slightly flushed with purplish on the back, and with the throat and middle lobe and one side of each lateral lobe of the lower lip orange-yellow ; tube 8-13 lines long abruptly contracted into the slender part, which is 3-7 lines long ; lobes 4-6 lines long, the three outer oblong and about 3 lines broad, the three inner distinctly cordate or ear-lobed at the base and 3½-5 lines broad, with the lower margins of the lateral pair incurved, all obtuse.—*Gladiolus corymbosus*, Burmann, *Fl. Cap. Prod.*, p. 2 (1768), and N. E. Br. in *Kew Bull.*, 1929, p. 132. *Tritonia odorata*, Loddiges, *Bot. Cab.* t. 1820 (1832). *Freesia odorata*, Ecklon ex Klatt in *Linnaea*, v. xxxiv, p. 672 (1866) ; L. Bolus in *S. Afr. Gardening*, 1929, p. 385, with fig. ; Neubert, *Deutsch Gart. Mag.*, 1883, p. 289.

Humansdorp Div. : Hankey, *Paterson* 3194! Groot Hoek, *Fourcade* 745! Kouga, 2200 ft. alt., *Fourcade* 3122! Uitenhage Div. : between Zwartkops and Sundays Rivers, *Ecklon* 286! between Van Stadensberg

and Zwartkops River, *Zeyher* 4026! near Zwartkops, *Brak* 7! *Tredgold* 35! *Bowie*! *Pappe*! *Kemsley* 1139! Bathurst Div.: between Blaauw Krantz and Kaffir Drift, *Burchell* 3652! 3711! between Bushmans River and Karega River, *Ecklon and Zeyher Irid.* 108! Albany Div. : near Grahamstown, *Burke*! *Glass* 558! *MacOwan* 90! *Atherstone*! *Galpin* 153! 207! *Rogers* 27576! *Zeyher*! *Dyer*! Salisbury, *MacOwan* 90! *Dregé* 593! Fish River Rand, *Hutton* 495! near Haarlem, *Schonland* 3098! Alicedale, *Cruden* 44! Peddie Div. : Line Drift, *Sim* 4083!

Var. *aurea*, N. E. Br. This is a variety that is stated to be " quite scentless," but otherwise only differs from the ordinary form by its shorter and rather broader flowers, which are about 13-14 lines long with the funnel-part of the tube 6-7 lines in diameter, and the colour is of a rich deep orange-yellow, more intense than in other forms.—*F. aurea*, Henderson ex Gumbleton in *Gard. Chron.* 1896, v. xix, p. 392, and 1902, v. xxxi, suppl. p. ii ; *Garden*, 1909, p. 591.

Locality unknown : of this I have seen only a cultivated specimen from *Gumbleton*!

F. corymbosa is widely known in herbaria as being *F. refracta*, Klatt, some of the specimens being so named by Klatt himself, and it is this misidentification that has caused so much confusion. For although Klatt saw and autographed the type specimen of *Gladiolus refractus*, Jacq. (on which *F. refracta* is founded) he confused *F. corymbosa* with that species, and botanists (myself included) accepted that determination as correct because the true *F. refracta* has hitherto remained unknown to them. When publishing my account of Burmann's S. African Iridaceae, believing Klatt could not make such a mistake in identifying this very distinct species, I referred *F. refracta* as a synonym of *F. corymbosa*, which, now that I have been able (through the courtesy of the Director of Vienna Herbarium) to examine the type of *Gladiolus refractus*, Jacq. on which *F. refracta* was founded, I find to be quite wrong, and the same error was repeated in *Gard. Chron.* 1932, v. xcii, p. 467, and in *S. Afr. Gard.*, 1933, p. 263, both accounts being written long before I began to investigate this genus critically.

When Klatt published *F. refracta* in *Linnaea*, v. xxxiv, p. 673 (1866), he quotes for it specimens in Berlin Herbarium collected by Drége and by Mund and Maire. These (by the courtesy of the Berlin authorities) I have now been able to examine, and find that the specimen collected by Drége is identical with those of Ecklon and Zeyher Irid. 108, which he describes as *F. odorata*, Eckl., and both are the same as *Gladiolus corymbosus*, Burm. with which I have compared them ! The Mund and Maire specimen, however, is a totally different species and identical with

F. Muirii, N. E. Br. This means that Klatt actually confused three perfectly distinct species under the name *F. refracta*!

Under cultivation the leaves (as in other species) are usually longer than those of wild plants, and Mr. R. A. Dyer informs me that under cultivation at Grahamstown this short-leaved wild plant develops leaves 12-16 inches long, of which there is an example in Kew Herbarium ; the flowers, however, do not alter in character.

The variety *aurea* on account of its rich colour has been much used for hybridising purposes, the hybrid *F. Chapmanii* being one of the results.

11. F. REFRACTA, Klatt in *Linnaea*, v. xxxiv, p. 673 (1866). Plant 6-18 inches high. Leaves ascending, 3-15 inches long, 2-5 lines broad, linear, tapering to a very acute point, not or but very slightly broadened at or below the middle and, according to Gumbleton, " of a much deeper shade of green than in any other Freesia " in cultivation in 1896. Stem usually branched, sometimes simple, overtopping or occasionally only equalling the leaves, glabrous. Bracts $2\frac{1}{2}$-3 lines long, membranous, variably subtruncate or rounded and apiculate or acute at the apex on different specimens, whitish or pallid with faintly purplish veins or purplish tinted at the apex (in Ker's figure they are wrongly coloured brown). Flowers 14-18 lines long, dingy greenish yellow, suffused with dull violaceous or purplish on the back of the upper lobes, and the three lower lobes marked with fulvous or brownish yellow, each with a purple mid-line ; tube 9-12 lines long, abruptly contracted into the slender part which is $2\frac{1}{2}$-4 lines long ; lobes 4-6 lines long ; the outer 2-$2\frac{1}{2}$ lines broad, oblong ; the inner 3-4 lines broad, ovate and cordate or ear-lobed at the base, the lower pair having inrolled margins, all obtuse.—*Gladiolus refractus*, Jacq. *Icon. Rar.*, v. ii, p. 4, t. 241 (1786), and *Collect. Suppl.*, p. 26 (1796) ; Redouté, *Liliaceae*, t. 419 (1813). *G. resupinatus*, Persoon, *Synop. Plant.*, v. i, p. 45 (1805). *Tritonia refracta*, Ker in *Ann. of Bot.*, v. i, p. 228 (1804), in *Bot. Reg.*, 1816, t. 135, and in *Irid. Gen.*, p. 119. *T. securigera* d, partly, Drége, *Docum.*, p. 123. *Freesia refracta*, Foster in *Gard. Chron.*, 1888, v. iii, p. 588 ; Gumbleton in *Gard. Chron.*, 1896, v. xix, pp. 391, 392, f. 51 ; Bailey, *Cyclop. Hort.*, p. 609, f. 870, and *Standard Cyclop. Hort.*, p. 1277, f. 1578. (Several other figures are published under the name of *F. refracta*, but as I have not seen them they are not quoted here.) *F. Metelerkampiae*, L. Bolus in *S. Afr. Gard.*, 1927, p. 336, as to the text but not as to the figure. *F. Hurlingii*, L. Bolus in *S. Afr. Gard.*, 1933, p. 111, with figure.

Worcester Div. : between Osplaats and Tunnel Sidings, *Rogers* 16739! Riversdale Div. : Hooge Kraal, *Drége*! near Riversdale, *Muir* 4432! *Ferguson*! Snijmans Kraal, *Muir* 4433! Swellendam Div.: at Bonnievale, *Hurling and Neil*! and cultivated specimens including Jacquin's type!

F. refracta is the oldest generally known name in the genus, and was described and figured from cultivated plants, yet it is remarkable that in all the herbaria examined there are only four cultivated specimens preserved, the type and two others in Vienna herbarium, and a very poor one in Lemann's herbarium at Cambridge, which is from a plant cultivated at Kew prior to 1852. Two of these have the spike continuous with the stem just as Redouté represents, instead of being abruptly bent from it. I have never seen it alive, as the plants so named that I have seen were not this species, and Ker and Gumbleton have both stated that it was rare in cultivation when they wrote of it.

Although Klatt saw, described and has named and autographed Jacquin's type specimen of *Gladiolus refractus* as being *F. refracta*, Klatt, he does not quote it at the place of publication. But the specimens of Drége and Mund and Maire in Berlin herbarium, which he does quote as being *F. refracta*, are misidentifications, one being identical with *F. Muirii*, and the other with the species he describes on the same page as *F. odorata*, Eckl., which is a synonym of *F. corymbosa*. And it is *F. corymbosa* that Klatt has named as being *F. refracta* in Kew herbarium, and it is so named in other herbaria. It is this misidentification that is so misleading and has caused much confusion.

The locality from which the type was introduced is not known, but it was rediscovered by Drége over 100 years ago, and later by others. The Bonnievale specimens, which are identical with Jacquin's type, have been described by Mrs. Bolus as a new species.

As S. African botanists in *S. Afr. Gard.*, 1933, p. 111, have asserted that the figure in the *Botanical Register*, 1816, t. 135, does not represent the same plant as the figure of *Gladiolus refractus*, Jacq. Icon. Pl. t. 241, I may mention that they are considered to represent the same plant by European botanists and horticulturists alike, especially those who have seen the plant alive. Prof. Michael Foster at the place quoted remarks that Jacquin's figure " seems to be the same (as Bot. Reg. t. 135), but the drawing is very inferior and difficult to judge by." I find no fault with the drawing, but the coloration is decidedly bad and does not at all agree with Jacquin's description, which states that the flowers are " dingy yellow, dull purplish on the back of the lobes ; the lower three lobes marked with a dull purple midline, and the two lateral with fulvous margins on the inner side, and the middle one with both margins fulvous." No difference whatever can be seen in the structural characters represented in the three figures cited ; it is the coloration that is faulty. Jacquin's description well agrees with the specimens quoted and with the descriptions of Foster and Gumbleton, who described from living plants.

As pointed out in the *Gard. Chron.*, 1932, v. xcii, p. 467, and in *S. Afr.*

Gard., 1933, pp. 262, 263, the name *F. Metelerkampiae*, L. Bolus was based solely upon the figure in *Botanical Register*, t. 135, but the plant figured under that name is a totally different species and is a palpable misidentification ; according to *S. Afr. Gard.*, 1929, p. 385, Mr. Fourcade identified the plant figured as being *F. Armstrongi*, in which I believe him to be correct, or that it is a hybrid derived from that species.

12. F. Muirii, N. E. Br. in *Gard. Chron.*, 1932, v. xcii, p. 467. Plant varying under natural conditions from 6 inches to 2½ feet high. Leaves ascending or suberect, 2 inches to 2 feet long on native plants, 2-6 lines broad, soft and grassy, linear, acute or tapering to an acute point. Stem shorter or longer than the leaves, simple or branched, quite glabrous or with microscopic points on the lower part. Bracts 2-4 lines long, green. Flowers 1¼-1¾ inches long, white or pale yellow, with rich yellow or orange-yellow blotches on the lower lobes and the slender part of the tube also yellow ; in the process of drying or when fading the lobes often change to a light violaceous colour ; tube 10-14 lines long, rather abruptly passing into its slender part, which is 2½-3 (rarely 4) lines long ; lobes 6-7 lines long and 3-4½ lines broad, all oblong or elliptic-oblong, slightly and gradually narrowing to the base, obtuse.—*Tritonia securigera* d, partly, and e, Drége, *Docum.*, p. 123.

Riversdale Div. : Hooge Kraal, *Drége*! near Riversdale, *Muir* 383! 4504! 4505! *Ferguson*! Mossel Bay Div. : Mossel Bay, *Drége*! *Rogers* 4146! *Muir* 4849! 4849b! *Prior*! *Penther* 768! Bredasdorp Div. : on the farm Nachtwacht, *Smith* 3045! Without locality, *Breutel* 23! a specimen cultivated at Kew before 1852 in Cambridge Herbarium! and another in Berlin Herbarium collected by *Mund and Maire* and quoted as being *F. refracta* by Klatt!

This and *F. refracta* are very variable in size under natural conditions, and few would at first think the small form with leaves only 2-7 inches long could be the same species as specimens with leaves 1½-2 feet long ; the flowers, however, are identical, and both forms grow in the same locality, but probably receive a different amount of water.

13. F. Sparrmannii, N. E. Br. in *Fl. Pl. S. Afr.*, v. i, under t. 11. Plant 4-8 inches high, leaves ascending, 2-6 inches long, 2-4 lines broad, linear, tapering to an acute point. Stem not or scarcely overtopping the leaves, branched, glabrous or with microscopic points or microscopic hairs on the lower part. Bracts 2-2½ lines long, green. Flowers 12-15 lines long, apparently white or creamy ; tube about 9 lines long, tapering into the slender part, which is 5 lines long ; lobes 5 lines long and 1½-2 lines broad, all oblong, very slightly and gradually narrowed at the base, obtuse or subacute.—*Gladiolus Sparrmannii*, Thunb. in *Kongl. Vet. Acad. Handlingar*, 1814, p. 189, t. 9A, and *Fl. Cap.*, ed. Schultes, p. 49.

Swellendam Div.: Along the Buffeljagts River, *Zeyher* 4027! and without precise locality *Sparrmann* in Thunberg's herbarium!

Thunberg describes the flowers as "blue and white," by which he doubtless meant they were white inside with a bluish or violaceous tint on the outside of the upper lobes. He received the specimen from Sparrmann in or before 1814. I have been able to compare it with Zeyher's 4027 and find it identical with that plant, which is named "*F. refracta*" by Klatt in Vienna herbarium.

The stem of different specimens varies from glabrous to besprinkled with minute points, to others with distinct minute hairs, visible only under a strong lens, and on one specimen seen with two stems from the same bulb one stem is glabrous and the other has minute points upon it.

For *F. Sparrmannii*, L. Bolus see *F. flava*.

14. F. GENTILIS, N. E. Br. Cultivated plant about a foot high, probably dwarfer in a natural state. Leaves ascending, 5 or 6 to a corm, 5-7½ inches long, 3-5½ lines broad, abruptly and considerably broadened on the upper edge at about an inch above the base, broadly linear, rather shortly acute at the apex. Stem simple or branched, glabrous or sprinkled on the lower part with microscopic points, seen only with a strong lens. Terminal spikes 8-11-flowered. Bracts 4-5 lines long and the outer rather longer than the inner, obtusely rounded at the apex, green or tinted with purplish, and with membranous margins. Flowers 2-2¼ inches long, apparently creamy or light yellow within, without any W-shaped or other marking in the tube, the lower middle lobe and basal part of the tube is orange-yellow, and the three upper lobes are sometimes flushed with the purplish on the back; tube 17-18 lines long, nearly straight, the flower being slightly turned back at the base only, and the funnel-shaped part tapering into the slender part, which is 5-6 lines long; lobes 9-10 lines long unequal in breadth, the dorsal one about 6 lines broad and concave ?, the lateral 4-5 lines broad, and the middle lower one about 3-3½ lines broad, all oblong, obtuse, slightly narrowed at the base.

Carnarvon Div.: Van Wyks Vley, *Alston*!

Described from dried specimens of cultivated plants grown from bulbs sent by Mr. E. G. Alston from Van Wyks Vley to Cape Botanic Garden, probably in 1892, when he also sent *F. Andersoniae* from the same locality. The type is in Cape Town Herbarium and a portion of it at Kew, and is named by Prof. MacOwan as being *F. refracta*, Klatt, from which it is entirely different. The dried specimens much resemble those of *F. Andersoniae* from the same locality, but distinctly differ in their more abruptly pointed and less acute leaves, which are also much more abruptly broadened on the upper edge above the base than they

are in *F. Andersoniae*. The bracts are less membranous and the outer one is rather longer (not shorter) than the inner, more obtuse and without the blackish tips. The tube of the flower is without a trace of the W-shaped markings characteristic of *F. Andersoniae*, and the lobes seem more irregular in their breadth.

15. F. PICTA, N. E. Br. Plant 5-8 inches high or taller under cultivation. Leaves about 7 to a corm, ascending, 2-6 inches long, $2\frac{1}{2}$-$3\frac{1}{2}$ lines broad or larger under cultivation, linear, tapering to an acute point. Stem not overtopping the leaves, branched, glabrous or sprinkled below with microscopic points, even sometimes on the same specimen where two stems are present. Bracts 4-6 lines long, green, often more or less tinted with purplish. Flowers $1\frac{1}{2}$-2 inches or more long, with the upper three lobes apparently creamy or pale sulphur-yellow within and purplish on the back, and the lower three lobes perhaps yellow, of which the lateral have darker yellow or orange margins and the middle one is darker than the others or orange-yellow ; the base of the funnel-shaped part and the slender part of the tube is also orange-yellow ; tube 12-18 lines long, gradually tapering into the slender part, which is 5-7 lines long ; lobes 7-10 lines long, 3-$4\frac{1}{2}$ lines broad, all oblong, obtuse, slightly and gradually narrowed at the base.

Beaufort West Div. : Without precise locality, *Black*! and cultivated specimens!

Judging from the specimens seen, mostly cultivated, this is the handsomest species of the genus. A specimen in Zurich Herbarium is about 15 inches high, with leaves 9-12 inches long and 3-4 lines broad, all other specimens seen being of the size given above.

16. F. XANTHOSPILA, Klatt in *Linnaea*, v. xxxiv, p. 673 (as to description partly and the figure quoted, but excluding the synonym and specimen quoted, for which see *F. Herberti*). Plant 6-10 inches high. Leaves erect or ascending, 3-8 inches long, 3-$5\frac{1}{2}$ lines broad, broadly linear to lanceolate-linear, usually somewhat abruptly broadened on the upper edge below the middle, shortly or somewhat abruptly acute at the apex, not gradually tapering to a point, thin and grassy in texture, glabrous. Stem not or rarely overtopping the leaves, simple or occasionally branched, sprinkled with microscopic points only visible under a strong lens. The spike of the specimens seen and in the original figure is more or less continuous with (not abruptly bent from) the stem. Bracts $3\frac{1}{2}$-4 lines long, very shortly pointed, green. Flowers 18-23 lines long, white, with a blotch of yellow on the lower lobes or lower middle lobe, and the base of the funnel-shaped part of the tube also yellow ; tube 10-13 lines long, abruptly contracted into the slender part, which is 4-5 lines long ; lobes about 7-8 lines long, $3\frac{1}{2}$-4 lines broad, all oblong,

obtuse, slightly tapering at the base.—*F. xanthospila*, Klatt, *Ergänz.*, p. 26, excluding synonyms not quoted here and the specimen quoted, which latter belongs to *F. lactea*. *Gladiolus xanthospilus*, Redouté, *Liliaceae*, t. 124 (1807). *Sparaxis Jouberti*, Lodd. in *Delect. Hort. Dresden*, 1833 and 1835, ex Walpers, *Ann. Bot.*, v. vi, p. 49. *Tritonia xanthospila*, Ker ex Spreng. *Syst.*, v. i, p. 154. *Montbretia xanthospila*, Heynhold, *Nom. Bot.*, v. ii, p. 418.

South Africa : Locality and collector unknown, cultivated specimens!

Var. Leichtlinii, N. E. Br. Plant like the type in habit and foliage. Stem branching or simple, usually sprinkled with microscopic points on the lower part, but sometimes glabrous. Bracts and flowers as in the type except that the lobes and tube of the flower are yellow, with the three lower lobes marked with orange blotches.—*F. Leichtlinii*, Klatt in *Gartenfl.* 1874, p. 289, t. 808, and *Ergänz.*, p. 26 ; *Floral Mag.*, 1875, No. 45, with fig. ; *Gard. Chron.*, 1875, v. iii, p. 590, f. 121, and 1888, v. iii, pp. 588 and 589, f. 79 ; Neubert, *Deutsch Gart. Mag.*, 1883, p. 289 ; *Garden*, 1909, p. 590. *F. Leichtliniana*, Burbidge, *Floral Mag.*, 1876, t. 218. *F. refracta* var. *Leichtlinii*, in *Garden*, 1882, v. xxiv, p. 94, with coloured fig. ; Bailey, *Cyclop. Amer. Hort.*, p. 608, f. 869, and *Stand. Cyclop. Hort.*, p. 1278, f. 1579. *F. Leichtlinii* var. *major*, Gumbleton in *Gard. Chron.*, 1896, v. xix, pp. 392 and 397, f. 54, a large-flowered form.

South Africa : Locality and collector unknown, cultivated specimens only seen! Among them is one sent to Kew in 1873 by Max Leichtlin under the name " *F. Leichtliniana*, Klatt," so that this is doubtless from a type plant. And Prof. Michael Foster states that the plant he describes and figures in the *Gardeners' Chronicle*, 1888, above quoted, was also obtained from Mr. Max Leichtlin.

I have seen typical specimens of *F. xanthospila* in Vienna Herbarium, one of them being so named by Klatt himself and signed by him, and as it appears undoubtedly to be the same as *Gladiolus xanthospilus*, Redouté may be accepted as a type of the species. The label bears upon it the name " *Sparaxis Jouberti*, Lodd," of which no description was published.

The native locality of neither the type nor the variety is known, but as they appear to differ only in the colour of their flowers, and dried specimens of them are sometimes scarcely distinguishable on account of change of colour, I think it probable that when the locality is discovered the white and the yellow-flowered forms may be found growing in the same general area, just as white and pale yellow forms of *F. Muirii* are found growing in the same area. Possibly the variety *Leichtlinii* may be the plant alluded to as having " pale golden daffodil " flowers by MacOwan in his letter quoted under *F. lactea*. But in that same letter he also remarks : " We got seed of *F. Leichtlinii* from Vilmorin, grew it to

flower and should have thrown it aside as a poor form of the yellow *refracta*, and scarce worth distinction as a garden variety. I send you a flower of this." The flowers sent and which are preserved at Kew are those of typical *F. Leichtlinii*, and in their bracts and structure are totally different from the " yellow *refracta*," i.e. *F. corymbosa*. This statement of MacOwan's and the fact that in the Cape Herbarium he has mounted specimens of *F. Leichtlinii* and *F. corymbosa* on the same sheet (No. 20972) as being the same species demonstrates, as elsewhere noted, that little attention has been paid by most botanists and horticulturists to the distinctive structural and other characters these plants have. This want of knowledge has caused many botanists (including myself) to make gross misidentifications of these plants as an examination of the nomenclature found in various herbaria will testify. For unless one does know of these characters and pays strict attention to them it is quite easy to misidentify allied species.

Concerning my former reference of *F. xanthospila* as a synonym of *F. caryophyllacea* see note under that species on p. 13 and under *F. corymbosa*, p. 16.

The variety *Leichtlinii* was evidently imported into Italy before 1873, as it is stated to have been found by Max Leichtlin among some neglected plants in the Botanic Garden at Padua ; its previous history is unknown.

17. F. LACTEA, Fenzl ex Klatt in *Zeitschr. Schweizerischen Gartenbauvereins*, 1881, p. 37, t. 3, under *F. refracta alba*, Klatt. Plant 8-10 inches high. Leaves ascending, narrow, 3-7 inches long, 2-4 lines broad, or under cultivation sometimes much broader, as Prof. Michael Foster has described them as being " 5 lines to 1 inch broad," linear, with only a slight and gradual rise on the upper edge at the lower part, tapering to an acute apex. Stem about as long as the leaves, usually branched, sometimes simple, glabrous or with microscopic points on the lower part. Bracts 4-6 lines long, thin, green. Flowers 2-2½ inches long, entirely white except at the lower part of the tube, which is yellow ; tube 15-18 lines long, with the slender part 6-8 lines long and the upper part gradually tapering into it ; lobes subequal, 6-7 lines long, 3-4 lines broad, oblong, obtuse, all gradually and slightly narrowed at the base.—*Freesia alba*, Foster in *Gard. Chron.*, 1888, v. iii, p. 588 ; Baker, *Handb. Irid.*, p. 167 (1892), not of L. Bolus. *F. refracta* var. *alba*, *Gard. Chron.*, 1878, v. x, p. 23, name only, and Klatt as above quoted ; *Garden*, 1881, v. xix, p. 465, and 1882, v. xxii, p. 94, with fig., and 1887, v. xxxi, p. 529 ; *Amer. Gard.*, v. ii, p. 25, f. 35 ; *Gartenfl.*, 1888, p. 412, f. 94, and 1889, p. 356, f. 59 ; Orcutt in *West Amer. Scien.*, 1895, p. 6 ; Neubert, *Deutsch Gart. Mag.*, 1895, p. 277 ; Mollers *Deutsch Gart. Zeit.*, 1896, p. 78 ; *Journ. Hort.*, 1900,

p. 197 ; Bailey, *Cycl. Amer. Hort.*, p. 609, with fig. ; *Rev. Hort. Belg.*, 1912, p. 12. *F. Sparrmannii* var. *alba*, N. E. Br. in *Fl. Pl. S. Afr.*, v. 1, under t. 11 ; and the synonymy and specimen wrongly quoted under *F. xanthospila*, Klatt, *Ergänz*, p. 26.

Knysna Div. : Plettenberg Bay, *Keet* 1021! The Heads, *Keet* 1042! Knysna Forests, *E.S.C.A. Herb.* 439! Knysna, *Miss Newdigate* ex Klatt Cape Div. : Table Mountain, doubtless escaped from cultivation, *Rehmann* 594! gardens at Cape Town, *Tyson* 2473! Division ? *MacOwan* 2482! Venezuela : Caraccas Prairie (in 1884), introduced, *Ernst*! And cultivated specimens!

The origin and history of *F. lactea* seem rather obscure and appear to be unknown in S. Africa, as a fairy-tale has been written to account for its origin. The following, however, are the statements published concerning it. The earliest mention I can find of the name " *F. refracta* var. *alba* " is that it was exhibited in London at a Flower Show of the Royal Horticultural Society by the New Bulb Co. on July 2nd, 1878, under that name and was awarded a certificate of merit. In Vienna herbarium there are cultivated specimens of it dated March 10th, 1878, and named " *F. refracta*, Klatt," so that it was probably introduced into Europe in 1877. In 1888 Prof. Michael Foster, at the place above quoted, founded *F. alba* upon " the *Freesia refracta alba* of the trade ; it does not wholly correspond to *Gladiolus xanthospilus* of Redouté's *Liliaceae*, or to any figure or description of the older writers. It seems to me a distinct type which I should propose to call *F. alba*." Baker adopts the name but does not refer to the author of it. Both Foster and Baker overlooked the fact that Klatt had previously published under his original description and figure of the plant the name *F. lactea* Fenzl had given it. Baker quotes MacOwan 2482 as being the type of *F. alba*, although his description ill accords with it. This specimen of MacOwan 2482 exactly corresponds with Klatt's excellent figure of *F. lactea* (*F. refracta alba*) and with the Vienna specimens dated 1878, which were possibly derived from the same source as the plant figured by Klatt, and it is also identical with other cultivated specimens of that period, and must, therefore, be accepted as typical *F. lactea*. This specimen of 2482 was collected by MacOwan in Sept., 1882, and received at Kew in March, 1884, and is labelled as " from cultivated bulbs brought from the district of Caledon." This statement of its origin conforms with an account published in the *Gardeners' Chronicle*, 1888, v. iii, p. 492, by H. Chalwin and P. MacOwan, where the latter states : " I believe the original locality whence the white Freesia was obtained by Ecklon and Zeyher was not far from Bredasdorp, at a farm called Zoetendaals Vley and towards Cape Agulhas." And he remarks on p. 493 : " I have added the locality whence Ecklon and

Zeyher are believed to have got the white Freesia and where it is said to have been originally found by Upjohn." This mention of Upjohn is significant as will be shown later. He then continues : " The yellow Freesias are quite eastern ; they come to us from the neighbourhood of Uitenhage. Many of Ecklon and Zeyher's exsiccata are marked A.D.B.G., that is *aus dem botanischen Garten*—meaning the plot of ground where Advocate Joubert permitted Ecklon to cultivate his bulb stock. As the *Topographisches Verzeichniss* (a pamphlet published by Ecklon) is dated 1827, there is reason to conclude that this Freesia has been under culture for at least sixty years, and by perpetual selection of the whitest flowers the present garden form has been fixed. Now and then in our gardens plants appear exactly resembling Redouté's fig. 124, *Gladiolus xanthospilus*, with short scape, abundant foliage and perianth yellow-stained within, purplish without. As a rule these are rogued out. I do not remember to have seen a truly wild example of the white-flowered plant. There are only garden examples in the Cape Government Herbarium." [N.B.—The only specimen of this plant seen by the writer in that herbarium at this date, Dec., 1933, is one labelled " No. 20972 *F. refracta*, Klatt," without information !] " My conclusion is that *F. odorata alba* so called, is *F. xanthospila*, Klatt, and that the type form is fig. 124 of Redouté's Liliaceae."

And in a letter received at Kew in May, 1884, from Prof. MacOwan, after remarking that " *F. refracta* is the Eastern Province plant," he states : " All along the coast from Cape Point towards Agulhas—notably near Mossel Bay—the other Freesia grows wild. I have never seen it in my Eastern Province peregrinations. It grows from the bulb with perfectly erect leaves. The colour varies very much from pale golden daffodil to pure white, and is either with or without purplish stains on the outside of the perianth segments. Here (i.e. at Cape Botanic Garden) we paid much attention to this lovely bulb, grew it year after year, roguing out all the yellow and purple stained individuals and sowing the whitest. This is the *Freesia refracta alba* of gardens. But it is, I believe, only a variety of *F. xanthospila*, Klatt = *Gladiolus xanthospilus*, Red. *Lil.* t. 124, which figure represents a badly-stained form."

I have quoted the above in full because, according to Mrs. Bolus in *A Book of South African Flowers*, p. 120 (1925), as noted under *F. Andersoniae* on p. 29, the same theory of the origin of *F. lactea* seems still to prevail in S. Africa.

The above statement, however, appears to be without the slightest foundation of fact, as I have not found any evidence that Ecklon and Zeyher knew anything whatever about this white Freesia ; no specimen of it from them exists in the Cape or any other herbarium I have

examined. And surely if the plant had been in cultivation in S. Africa for 60 years before 1888, when MacOwan wrote of it as quoted above, it would have been introduced into Europe earlier, yet until 1878 *F. refracta alba* was unheard of. Also, in the area mentioned by MacOwan there are several very distinct species of Freesia, but as some of them have a superficial resemblance to one another it is evident MacOwan mistook them all for one species ; and as he failed to notice the very obvious structural characters that distinguish *F. corymbosa* from *F. xanthospila* var. *Leichtlinii* (see note under that variety), it is probable he overlooked all other specific characters, as Marloth also did. Therefore it seems reasonable to suppose that when MacOwan took charge of Cape Town Botanic Garden in 1881 he made a mistake in considering the whole of the Freesias growing there to belong to one species, and that by destroying all the coloured species he really conserved a distinct native white species, which is quite different from any other in leaves, bracts and flowers. MacOwan connects Ecklon with *F. refracta* var. *alba*, but Ecklon died in 1868, twenty years before MacOwan published the above account, and, as above mentioned, there is no evidence to show that Ecklon had any knowledge of *F. lactea*, nor is the native locality of this plant either near Bredasdorp or in Caledon Division.

It is remarkable that although MacOwan sent a dried specimen of *F. lactea* to Kew under No. 2482, there is no specimen of it in his own herbarium, now in Albany Museum. But in Berlin herbarium is a sheet of specimens from MacOwan's herbarium absolutely identical in every particular with MacOwan 2482 at Kew. This sheet is labelled in MacOwan's handwriting — "Herbarium Macowanianum. *Freesia xanthospila*, Klatt. Culta in hortulo meo ad Somerset East e bulbis spontaneis ab beat. Upjohn missis." This label is not dated, but it proves that Prof. MacOwan had native bulbs of this plant sent to him (without statement of locality ?) by a Mr. Upjohn, which he cultivated at Somerset East before 1881, when he left there to take charge of Cape Town Botanic Garden. In the account previously quoted MacOwan vaguely mentions the discovery of this plant by Upjohn, but does not say at what date, and evidently the expression "beat. Upjohn" on MacOwan's label means that Upjohn was dead when that label was written. I fail to learn anything of Upjohn except that he probably lived at Uitenhage, which is significant as being within reach of Knysna Division, the native home of *F. lactea*, where it is probable Upjohn collected it, and it may possibly have been he who first introduced it into Europe in 1878 or earlier. The Knysna plant is in every way identical with MacOwan 2482 and with cultivated specimens of F. *refracta alba*.

Although *F. lactea* (under the name of *F. refracta alba*) was formerly exported from S. Africa to Europe and America in large quantities, and I understand is now commonly cultivated there, I have not seen a figure of it in any S. African botanical work. And if we may judge from the figures of the plant published by Mrs. Bolus in *S. Afr. Gard.*, 1933, p. 111, as being " *F. alba*, Baker," it would appear that the real *F. alba*, Baker is unknown to her, because those figures represent a totally different plant, which does not appear even to have entirely white flowers, as blotches are indicated on the lower lobes, so that evidently a misidentification has been made. Without specimens to examine I am unable definitely to refer the plant figured to any known species, especially as the brief account given on p. 112 (for there is no description of " *F. alba*, Baker ") entirely disagrees with the figures, which represent a plant with stiffly ascending leaves, while the account states : " I examined about fifty specimens on the Swartberg near Caledon of *F. alba*, and the leaves of all were pressed in fan formation to the ground." So that it would appear some other species (possibly *F. Muirii*) has been figured in mistake for the Caledon plant mentioned.

18. F. FLAVA, N. E. Br. Plant about 6 inches high. Leaves more or less spreading in fan-like manner, 1½-2½ inches long, 3-5 lines broad, narrowly oblong or oblong-lanceolate, abruptly acute or obtuse and mucronate. Stem branched, overtopping the leaves and excluding the flowers about 3 inches long in the specimen seen. Bracts 4-5 lines long, acute, membranous at upper half, with brown tips. Flower 2-2½ inches long, yellow, with an orange blotch on the middle lobe of the lower lip ; tube 18-21 lines long, abruptly contracted into the slender part, which is 8-10 lines long ; lobes 6-8 lines long, 4-5 lines broad, oblong or elliptic-oblong, obtuse, all slightly narrowed to the base. Style exserted far beyond the anthers and as long as or longer than the entire flower.

F. Sparrmanni, var. *flava*, N. E. Br. in *Fl. Pl. of S. Afr.*, v. i, t. 11 (1920). *F. Sparrmanni*, L. Bolus in *S. Afr. Gard.* 1933, p. 112, not of N. E. Brown.

Ladismith Div. : near Ladismith, *Shand*!.

Described from the specimen from which the above-quoted figure was made, now preserved in the National Herbarium at Pretoria. The figure represents the stem as simple, but the specimen has a branched stem, the upper part of the principal stem having been eaten off. The secondary branch that remains bears three flowers.

When the writer referred this plant as a variety of *F. Sparrmanni*, no specimen (only the drawing of it) had been seen and the whole genus was in such confusion that it could not be properly determined without

a complete examination of all the species, and being misled by MacOwan's note quoted under the plate mentioned, it was deemed better to refer it as a variety of *F. Sparrmanni* until better known.

Its clear yellow flowers distinguish it from all other known species except *F. Leichtlinii*, and from that the membranous bracts, longer slender part of the tube of the flower and the longer style easily distinguish it.

19. F. Andersoniae, L. Bolus in *S. Afr. Gard.*, 1927, p. 336, f. 1-2, and in *Nature Notes* 1927, No. 50, p. 6, f. 1-2. Plant 4-10 inches high. Leaves ascending, 2-10 inches long, 1-4 lines broad, linear, shortly acute or tapering to an acute apex. Stem about as long as or sometimes overtopping the leaves, simple or branched, glabrous. Bracts 4-6½ lines long, more or less membranous at the upper part, often tinted with pinkish and with acute blackish tipped points, the inner bracts longer than the outer. Flower 1¾-2¾ inches long, sometimes but not always bent slightly backward at the base as well as rather abruptly curved forward at the top of the slender part of the tube, sweetly scented; tube 15-25 lines long, with the upper part abruptly contracted into the slender part when alive, but dried specimens often appearing to be narrow and tapering into the slender part, which is 6-16 lines long; lobes subequal, 6-8 lines long, the outer 2½-3 lines broad, oblong and not narrowed at the base; the inner 3-4½ lines broad, ovate or ovate-oblong and narrowed in a curved line to the base, but not lobed there; all obtuse, apparently creamy white ("rich ivory" ex L. Bolus) or pale yellowish within with an orange-yellow blotch on all three or only the middle one of the lower lobes, and the outside of some of the lobes apparently suffused with purplish, the slender part of the tube is orange-yellow and on the lower side of the throat are three orange-yellow blotches outlined with W-shaped purple markings.

Bechuanaland: between Takun and the stone ruins of the original town of Litakun, *Burchell* 2269! Griqualand West: Herbert Div., *Anderson* 760! Warrenton, *Adams* 149! Hay Div.; Langberg, *Hunter* 20! Div.? abundant on rocky hills of Vaal River, *Hutton*! Prieska Div., near Prieska, *Bryant* 324! Hopetown Div.; near Hopetown, *Meteler-kamp*. Hanover Div.; near Hanover, *Vimpany*! Carnarvon Div.: Van Wyks Vley, *Alston*! Middelburg Div.; Conway Farm, *Gilfillan in Herb. Galpin* 5577! Orange Free State; near Fauresmith, *Smith* 385! 437! 487 [2]! Graaff-Reinet Div.; Sneeuwberg, *Bolus* 1806!

A very distinct species, easily recognised by its membranous acute bracts tipped with dark brown points and by the long and peculiarly curved tube of the flower. It varies greatly in the size of its flower, evidently in accord with the amount of water received; the largest dried

specimens seen were of cultivated specimens from Van Wyks Vley, where the tube is 20-25 lines long and 5-7 lines broad at the base of the lobes ; on the other hand, the wild specimens collected by Burchell in the arid region of Bechuanaland have the tube only 15-18 lines long and 4 lines broad at the base of the lobes ; other specimens have flowers intermediate in size, but all have the same characters.

F. Andersoniae is the most widely distributed species known and was discovered by Burchell on Sept. 15, 1812, now over 120 years ago as mentioned on p. 3, but was confused by Baker in *Fl. Capensis* with *F. refracta*, Klatt, from which it differs entirely in appearance and structure.

The plant represented by Mrs. Bolus as being " *F. refracta*, Klatt", in *Nature Notes*, No. 4, p. 7 (1923 ?) ; in *Protected Wild Flowers, series A ;* in *A Book of South African Flowers*, p. 120 (1925), and mentioned in *S. African Gard.*, 1933, p. 112, appears to be *F. Andersoniae*, for it certainly is not *F. refracta*, Klatt, its flowers, as represented, being totally different in size and shape from those of that species, and agreeing well with those of *F. Andersoniae*. The plant from which that figure was made is stated to have come from Oudtshoorn, but may have been only cultivated there. No description or other information is given of the plant. But in the above-quoted *Book of S. African Flowers*, p. 120, the following strange statement is made concerning it :—" All the various garden forms have been bred from this wild one and, perhaps, from another native S. African species. The horticulturists aimed with all their might at getting rid of the sulphur-yellow colour of the wild flower and at producing a pure white one." I am unable to find a particle of evidence in support of this remarkable statement, and believe it to be based upon the tradition of MacOwan's account of " *F. refracta alba* " published in 1888, which also seems without foundation, see under *F. lactea*, p. 25. In the first place there is no evidence that the plant Mrs. Bolus figures and which appears to be *F. Andersoniae* has ever been in general cultivation. And, secondly, the cultivated white-flowered plant alluded to is a native of South Africa, see *F. lactea*.

Rejected Species.

Freesia rubella, Baker in *Bull. Herb. Boiss.*, 1901, p. 868, from Delagoa Bay, Junod 166.

By the courtesy of Prof. Hans Schinz I have been able to examine the type of this species, which is in Zurich Herbarium, and find that it is not a *Freesia* but a species of *Watsonia*, so that it may now take the name of *Watsonia rubella*, N. E. Br.

Garden Hybrids of Freesia.

The following list enumerates only those which I have noted in the garden periodicals consulted, and must not be taken to be a complete list. They are mostly without descriptions :—

F. "Amethyst," *Garden*, 1911, p. 323, coloured figure.

F. Chapmanii, *Garden*, 1906, p. 99, and 1907, p. 165, with fig., and 1909, p. 591, with a coloured figure of this and other hybrids. Stated to be a hybrid between *F. refracta alba* (= *F. lactea*) as seed parent and *F. aurea* (= *F. corymbosa* var. *aurea*) as pollen parent.

F. excelsior, *Gard. Chron.*, 1914, v. lv., p. 152 ; *Journ. Roy. Hort. Soc.*, v. xl., *Proc.* p. 56, f. 32.—Leaves nearly an inch in breadth. Lobes of the flower all oblong, obtuse, none earlobed at the base, deep cream coloured, blotched with orange.

F. "Glow," *Garden*, 1911, p. 323, with coloured figure.

F. grandiflora virginalis, *Garden*, 1907, p. 165.—Flowers described as "white with a dash of yellow on one of the lower segments." Can this be the same as *F. xanthospila*, Klatt ?

F. hybrida, *Gartenwelt*, 1909, p. 678, with plate.

F. kewensis, *Journ. Hort.*, 1904, v. xlviii, p. 179 ; *Kew Bull.*, 1910, p. 323.—A hybrid between *F. Armstrongi* and *F. Leichtlinii*, raised at Kew in 1904, with flowers about an inch in diameter, having a long tapering tube and spreading lobes, pale lilac-pink, suffused with pale yellow in the tube.

F. "Lady Rose," *Garden*, 1911, p. 323, coloured figure.

F. "Le Phare," *Garden*, 1911, p. 323, coloured figure.

F. lilacina, see *F. odorata lilacina*.

F. luminosa, *Garden*, 1911, p. 323, with coloured figure.—Plant up to 30 inches high, very floriferous, having large lilac-rose flowers with a white throat, without other markings. (See *F. Tubergeni luminosa*.)

F. Maidenii, *Gard. Chron.*, 1911, v. l, p. 62.—A hybrid between *F. refracta alba* (= *F. lactea*) fertilised with pollen of *F. Armstrongi*.

F. odorata lilacina, *Gard. Chron.*, 1896, v. xix, pp. 392 and 397, f. 55.—A hybrid with large flowers, represented as about three inches long, "with a distinct lilac suffusing the lower portion of the tube and petals." No other information ; the flowers figured resemble those of *F. lactea* in form, but are larger.

F. "Purity," *Garden*, 1916, p. 133, with fig., and p. 178.—This is also called *F. refracta* "*Purity*."

F. TRICOLOR, *Gard. Chron.*, 1896, v. xix, p. 392.—Name only mentioned and the flowers stated to be "pale primrose."

F. TUBERGENI, *Garden*, 1906, v. lxix, p. 184, with fig.; *Journ. Hort.*, 1906, p. 299.—A hybrid between *F. refracta alba* (= *F. lactea*) and *F. Armstrongi*. Described as having "fragrant, lilac-coloured flowers, with white showing through here and there. In size and colour this Freesia is a great improvement upon *F. Armstrongii*." This was exhibited by the Firm of Tubergen at the Royal Horticultural Society on March 6th, 1906, and was awarded a certificate of merit. According to the figure the flowers are two inches long. Several varieties of it are figured in *Rev. Hort. Belge*, 1910, p. 265, where its history is given.

F. TUBERGENI LUMINOSA, *Rev. Hort. Belge*, 1910, p. 265. See *F. luminosa*.

F. VIRGINALIS. (See *F. grandiflora virginalis*.)

F. XANTHOSPILA BELLA, *Neubert, Deutsch Gart. Mag.*, 1893, p. 229; *Garten'ora*, 1893, p. 729; *Bull. Soc. Tosc. Ort.*, 1894, p. 19; and *Wien Illustr. Gart. Zeit.*, 1893, p. 338, f. 68. A garden variety with a yellow blotch on the lower lobe.

PLANTAE NOVAE AFRICANAE

" Ex Africa semper aliquid novi."—*Pliny.*

Series I.

By

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With Plates I, II and III drawn by Miss W. F. Barker.

Hessea karooica, Barker. (Amaryllidaceae) § Imhofia.

Bulbus oblongo-globosus, diam. 2 cm., long. 2·5 cm., in collum 2-4 cm. productus. *Folia* 2, hysterantha, obovata, obtusa, in petiolum breve basi attenuata, marginibus minute scabris. *Pedunculus* flexuosus, basi rubescens, long. 9-10 cm. *Umbella* 6-13-flora, floribus albis et rosaceis, diam. 1·1 cm. ; spatha 2-foliata, foliis lanceolatis acuminatis, papyraceis, purpurascens, ad long. 2·5 cm. *Pedicelli* adscendentes deinde patentes, long. 4·2 cm. *Perigonium* profunde sexpartitum ; segmenta obovata, subacuta, basi attenuata, patentissima, intus alba et rosacea lineata, extus laete rosacea lineata. *Filamenta* subulata, basi lata, subaequalia, erecta, segmentis breviora ; antherae parvae. *Stylus* albus base expansus superne subulatus ; ovarium globosum purpurascens, diam. 1·5 mm.

Hab. Cape Province ; Laingsberg Div., Matjesfontein, *H. H. W. Pearson,* April, 1914 (Nat. Bot. Gdns. 2499/14). *J. D. Logan* and *J. Archer,* 13th April, 1933 (A. No. 600), in flower : Aug. 1933, in leaf.

Hessea karooica finds a place in the subgenus Imhofia Baker on account of the swollen base of its style. From the older species it differs in its broad leaves in which character it approaches *H. Leipoldtii* L. Bolus. From that species, however, it differs in its suberect leaves whose margins are without the dense fringe of silky hairs.

Plate I, Fig. A (Logan & Archer 600).
1, bulb with fully developed leaves ; 2, flower front view × 3 ; 3, longitudinal section of flower ×3 ; 4, perianth segment with stamen attached × 3.

Hessea unguiculata, Barker (Amaryllidaceae) § Imhofia.

Bulbus diam. 3 cm., in collum elongatum productus, long. ad 5 cm. *Folia* 2, vel 3, erecta, laete viridia, nitentia vel glaucescentia, obtusa vel acuta, long. ad 10 cm., lat. ad 3 cm., plerumque ad medio latiora utrinque parum augustantia, interdum ad apice latiora, marginibus undulatis, minute ciliatis, supra convexa, superficie superiore base apiceque minute ciliata, una folia alterum amplectente. *Pedunculus* flexuosus, long. 30 cm., diam. 3 mm. *Umbella* ad 17-flora, floribus albis; spatha 2-foliata, foliis oblongo-lanceolatis, purpurascentibus, long. 2·5-3 cm. *Pedicelli* adscendentes, long. 3·5-6·5 cm. *Perigonium* profunde sex-partitum; segmenta exteriora acuta, interiora obtusa, patentissima, intus alba, extus rubro-lineata, long. 10 mm., lat. 5 mm., omnia basi unguiculata. *Filamenta* subulata aequalia segmentis breviora, long. 8 mm. *Stylus* albus, base expansus, superne subulatus; ovarium diam. 1·5 mm.

Hab. Cape Province; Clanwilliam Div., near Doornbosch, *T. M. Salter* 4441, May, 1934, in flower: June and July, 1934, in leaf.

Hessea unguiculata is nearly allied to *H. karooica* Barker, but differs in having leaves which are not distinctly attenuate at the base. Moreover, it has a much longer and stouter inflorescence and its flowers are larger. The segments are unguiculate at the base, and this character has suggested the specific name.

Plate I, Fig. B (Salter 4441).
1, young bulb with leaves not fully developed; 2, leaf from cultivated plant; 3, flower front view × 3; 4, longitudinal section of flower × 3; 5, outer perianth segment × 3; 5, inner perianth segment × 3.

Erica heleogena, Salter (Ericaceae-Ericoideae). § Ephebus.

Planta ad 60 cm. alta, in parte superiore ample ramosa. *Caulis* ramique erecti, glabri; ramuli graciles rubro-brunnei, partesque herbacei pubescentes pilis patentibus canis brevibus. *Folia* erecta vel erecto-patentia, 4-nata, linearia, subacuta, auguste sulcata (cum petiolis brevibus) 4-5 mm. longa, ad 0·4 mm. lata. *Flores* 1-3 nati vel rarius 4-nati, ramulos laterales breves terminantes, pedunculis 1·5 mm. longis. *Bracteae* 3, lineares, ad 1·2 mm. longae, basin versus vel infra medium pedunculi positae. *Sepala* e basi ovata submembranacea rubescente longe acuminata, superne linearia, foliacea sulcata, 2·5-3 mm. longa. *Corolla* rosea vel dilute rosea, patenter cano-pubescens, 5-6 mm. longa, elongate campanulato-cyathiformis, segmentis obtusis suberectis, 1 mm. longis, quam tubo pallidioribus. *Stamina* inclusa, filamentis 3·5 mm. longis, pallide roseis, antheris muticis, parum supra basin dorsifixis, oblique oblongis, basi subprognathis, 0·8-0·9 mm. longis, poro 0·2-0·3 mm. longo.

Ovarium depresso-globosum, glabrum, rubellum, stylo primo cum corolla aequante, deinde breviter exserto, stigmate capitellato.

Hab. Cape Peninsula ; marsh in upper part of Klaver Valley, near Simonstown, alt. 900 ft., flowers Jan.-Feb., *Salter* 1940 (*type* in Bolus Herbarium) 294/7 and 4265, *Pillans* 3594 and *Moss* 10469, loc. cit.

Allied to *E. paludicola*, L. Bolus, which it closely resembles in the dried state. It is, however, more robust in habit and differs in always having 4-nate leaves, a longer and distinctly pubescent corolla, longer sepals and a shorter pore in the anther cell. Described from living specimens.

As far as is known it is confined to two or three marshes in the locality given, where it grows abundantly amongst the marsh vegetation. It appears to have been mistaken by collectors for *E. cyrillaeflora*, Salisb., another rare species with a longer, narrow tubular corolla, which is believed to have been collected in the same valley, though it now seems to be extinct there. *E. cyrillaefora* occurs in a little-frequented marsh, about five miles distant in the same range of hills.

PLATE II, FIG. A (Salter 1940).
1, whorl of leaves × 6 ; 2, leaf upper side × 6 ; 3, flower × 6 ; 4, sepal × 12 ; 5, corolla × 6 ; 6, stamen back view × 12 ; 7, stamen side view × 12 ; 8, gynaecium × 12.

Erica capensis, Salter. (Ericaceae-Ericoideae). § Orophanes.

Planta erecta glabra 30-50 cm. alta. *Rami* virgati, valde erecti. *Folia* suberecta, imbricata vel rarius cum internodis aequantia, linlanceolata, sulcata (petiolo incluso) 4·5-6 mm. longa, petiolis fere 0·7 mm. longis, interdum minutissime ciliatis. *Flores* 2-5-nata, rarius 6-nata, saepe 4-nata, ramulos breves terminantes, apices versus ramorum dense cumulati, inferne sparsiores. *Pedunculi* circa 4 mm., rarius ad 6 mm. longi : bracteae 3, lineares, ad 1·5 mm. longae, infima parum infra medium, ceterae supra medium pedunculi positae. *Sepala* 2 mm. longa, e basi ovata vel orbiculare scariosa, retrorse ciliata, longe acuminata, superne subulata foliacea, carinata, leviter sulcata, rubra. *Corolla* cyathiformis, 4-5 mm. longa, laete rubra vel rosea vel alba, segmentis suberectis obtusis, 1-1·3 mm. longis. *Stamina* inclusa, filamentis superne subsigmoideis, 2 mm. longis, antheris dorsifixis, ovato-cuneatis, obtusis, basi obliquis, circa 0·7 mm. longis, poro dimidium lobi vel parum longiore, cristatis ; cristae auguste falcato-ovatae vel falcato-lanceolatae vel lineares, serrulatae vel rarius integrae, papyraceae, fere 0·5 mm. longae, partem superiorem filamenti ± breviter adnatae vel rarius liberae. *Ovarium* cylindricum, in adumbratione subquadratum, glabrum, stylo incluso, stigmate capitato.

Forma β (vix var.) Ad 90 cm. alta. Pedunculi longiores. Corolla pallide rosea vel alba. Cristae augustiores.

Hab. Cape Peninsula: plentiful in marshes on lower Hout and Klassjager Rivers, flowers Jan.-Feb., *Salter* 4292 (*type* in Bolus Herb.), 1860, 4262, 4289, 4290, 4291, 4293, *Potts* 4391. β on banks of a seasonal pool south of the mouth of Klaasjager River, *Salter* 2899, 4294-4298.

An exceedingly variable species. The red-flowered form, which has been taken as the type, resembles *E. laeta* Barth. var *incisa* in habit and appearance and has probably been mistaken for that species in the field. It differs very distinctly in the shape of the corolla, which is not constricted at the mouth and in the shape of the anthers. The white form is as plentiful as the red, and it is noteworthy that the corolla of *E. laeta* is *always* bright red. It appears to be confined to an area West and S.W. of Smitswinkel towards the Atlantic coast. Form β is, perhaps, scarcely a variety, though in the live state it is very different in appearance.

Ample material collected in the Hout River marshes, both of this species and *E. laeta*, together with several intermediate forms all growing in close proximity, indicate that the two species hybridise (vide *Salter* Nos. 4300 to 4307 and 4314 to 4317).

PLATE II, FIG. B (Salter 4292).
1, whorl of leaves × 6; 2, leaf upper side × 6; 3, flower × 6; 4, sepal × 12; 5, corolla × 6; 6, stamen back view × 12; 7, stamen side view × 12; 8, gynaecium × 12.

Erica Galpinii, Salter. (Ericaceae-Ericoideae). § Evanthe.

Planta robusta erecta, virgata, sparse ramosa, 1.5 m. alta. *Rami* glabri, tuberculis foliorum decurrentibus dense retrorseque pubescentibus, inferne nudi, superne dense foliati. *Folia* 4-nata, linearia, crassiuscula, erecto-incurvata, dense imbricata, subtus convexa sulcataque, glabra, angustissime membranaceo-marginata, 5-7 mm. longa (petiolis minute ciliatis inclusis). *Flores* 3-4 nati, ramulos breves terminantes, infra apices ramorum pseudo-racemosi. *Pedunculi* 1·5 mm. longi, minute pubescentes; bracteae late oblanceolatae, cuspidatae, valde viridio-carinatae, margine late membranaceo, 4-5 mm. longae, basin versus minute ciliatae, inferior in medio pedunculi posita, superiores calycem approximatae. *Sepala* obovata cuspidata, 5·5 mm. longa, sicut bracteae carinata, marginata, ciliata. Corolla tubulata, inaequale inflata, ore constricto, 1·8 cm. longa, glabra, laete sulphurea, segmentis semi-ovatis, 1·5-1·8 mm. longis. *Stamina* inclusa, antheris dorsifixis, oblongis, 1·7 mm. longis, poro dimidio lobi, aristis setiformibus pallidis 1·2 mm. longis. *Ovarium* brevissime stipitata, late obovatum vel subglobosum apice truncatum, glabrum, stylo corollam aequante, stigmate capitato.

Hab. Cape Province : Caledon Dist. ; Maanschyn Kop, Hermanus, on a moist slope near summit, alt. 2,900 ft., April, 1934, *E. E. Galpin* 12661. *Type* in Bolus Herbarium, also specimens in Nat. Herb., Pretoria, Herb. Kew, and Herb. Brit. Mus. from the same plant.

This species, of which only one plant has so far been found, has a bright sulphur-yellow corolla and is an affinity of *E. foliacea*, Andr. It differs in having obovate sepals, broad oblanceolate bracts and much shorter awns on the anthers.

PLATE II, FIG. C (Galpin 12661).
1, whorl of leaves × 3 ; 2, leaf upper side × 3 ; 3, flower × 3 ; 4, sepal × 3 ; 5, corolla × 3 ; 6, stamen back view × 6 ; 7, stamen side view × 6 ; 8, gynaecium × 3.

Erica eburnea, Salter. (Ericaceae-Ericoideae). § Orophanes.

Planta erecta ramosa glabra, ad 60 cm. alta. *Caulis* saepe 4 mm. lata, ramis numerosis erectis. *Folia* 4-nata suberecta, imbricata, anguste linearia, acuta subcarinata (cum petiolis brevibus) 3·5-5 mm. longa. *Flores* cumulati, plerumque 4-nati, ramulos breves terminantes, superiores saepe pseudo-umbellati : pedunculi graciles, 3-4 mm. longi : bracteae 3, lineares, 1-1·3 mm. longae, superiores subapproximatae, inferior remota. *Sepala* lineari-lanceolata, circa 1·5 mm. longa, e basi ovata scariosa, retrorse ciliata, superne subulata, foliacea, carinata, sulcata. *Corolla* late campanulato-cyathiformis, 3 mm. longa, eburnea, saepe leviter 4-nervosa, segmentis latis suberectis, circa 1 mm. longis. *Stamina* inclusa, filamentis e basi leviter attenuatis apicem versus subsigmoideis, 1·5 mm. longis, antheris dorsifixis plus minusve ovato-cuneatis, basi obliquis, 0·4-0·5 mm. longis, poro dimidio lobi vel paulo minore ; aristis lanceolatis non-adnatis, lobi dimidium aequantibus. *Ovarium* depresso-globosum, glabrum, stylo incluso, 1-1·5 mm. longo, stigmate capitellato.

Hab. Cape Peninsula : between Cirkels Vlei and Hester's Dam, in damp peaty ground and on stream sides, alt. 300-400 ft., flowers Nov.-Feb., *Salter* 4321 (*type* in Bolus Herbarium), 2923, 4312, 4318, 4320. Plain S.W. of Paulsberg, *Pillans* 4614.

An affinity of *E. turbiniflora*, Salisb., but with rather shorter sepals, a whitish corolla, distinct anthers with a shorter pore and linear-lanceolate awns almost free from the connective. It has probably been passed over for *E. subdivaricata*, Berg., a species which it greatly resembles in habit and for which I have mistaken it in the field. I am indebted to Mr. N. S. Pillans, perhaps the first collector, for bringing the differences to my notice.

PLATE II., FIG. D (Salter 4321).
1, whorl of leaves × 6 ; 2, leaf upper side × 6 ; 3, flower × 6 ; 4, sepal × 12 ; 5, corolla × 6 ; 6, stamen back view × 24 ; 7, stamen side view × 24 ; 8, gynaecium × 12.

Erica Krigeae, Compton, (Ericaceae-Ericoidcae). § Gypsocallis.

Frutex humilis, densus. *Caules* erecti, subflexuosi, dense puberuli, internodiis brevibus. *Folia* 3-nata, imbricata, erecta, incurvata, ovato-elliptica, crassa, obtusa, sulcata, superficie superiore concava, inferiore convexa, glabra, marginibus scabridis, long. 2·5-3 mm., lat. 1·5 mm. *Flores* subumbellati, terminales, c. 8-nata. *Pedicelli* canescentes, long. 4-5 mm. *Bracteae*, 2 approximatae, tertia approximata vel subremota, coriaceae, obtusae, cucullatae, marginibus breviter ciliatis. *Sepala* appressa, glabra, coriacea, colorata, obtusa, apice sulcato et subcucullato, marginibus breviter ciliatis. *Corolla* ovato-urceolata, glabra, roseo-tincta, tubo long. 2·5 mm., lat. 2 mm., lobis obtusis, long. 0·5 mm. *Filamenta* gracilia, long. 3 mm. *Antherae* long. 1 mm., oblongae, basifixae, bifidae, scabridae, muticae, exsertae, poro long. 0·4 mm. *Ovarium* globosum, glabrum. *Stylus* gracilis, long. 5 mm., stigmate exserto, capitellato.

Hab. Swartberg Pass, Prince Albert Division, Cape Province, c. 4,500 ft. alt. *A. M. Krige :* June, 1908 : in Herb. Bolus 13422. *Type.*

Swartberg Pass, Oudtshoorn Division. *W. Deas :* June, 1915 : in Herb. Muir 2156.

Swartberg, Prince Albert Division : *M. A. Pocock* S. 23 and S. 192 : May, 1926.

North side of Swartberg Pass : *Salter* 3124 : 24th April, 1933.

Erica Krigeae is related to *E. petraea* Benth., but differs greatly in its aspect, in the shape of the leaves, the subumbellate flowers with their longer pedicels, cucullate bracts and other details of floral structure. So far it has only been collected on the Swartberg Pass : *E. petraea* being localised in the neighbourhood of the Long Kloof.

PLATE III, FIG. A. (Salter 3124).

1, whorl of leaves × 12 ; 2, leaf upper side × 12 ; 3, flower × 6 ; 4, bract × 12 ; 5, sepal × 12 ; 6, corolla × 6 ; 7, stamen side view × 12 ; 8, stamen back view × 12 ; 9, gynaecium × 12.

Erica manifesta, Compton, (Ericaceae-Ericoideae). § Gypso-callis.

Fruticulus erectus vel expansus. *Caules* densc et minute deflexo-puberuli. *Folia* 3-nata, erecta vel appressa, elliptica, subacuta, dorso convexa, sulcata, glabra, long. 2·5-3 mm., lat. 1 mm., marginibus minute scaberulis. *Flores* numerosi, 3-1-nata, in ramulis lateralibus terminales, patentes vel cernui. *Pedicelli* curvati, puberuli, long. 1 mm. *Bracteae* 3, approximatae, ovatae, supra concavae, obtusae apiculatae, coriaceae, coloratae, glabrae. *Sepala* bracteis similia, late ovata, long. 1·5 mm., lat. 1·25 mm., marginibus scariosis. *Corolla* dilute roseo-tincta, glabra,

urceolata, tubo long. 2 mm., ore non constricta, lobis long. 1·25 mm., erectis vel subpatentibus, late deltoideis, leviter emarginatis. *Filamenta* long. 2 mm. *Antherae* manifestae, long. 1·25 mm., oblongae, leviter prognathae, basifixae, scaberulae, castaneae, poro ovale long. 0·5 mm. *Ovarium* depresse obcuneatum, glabrum. *Stylus* exsertus, long. 3 mm., stigmate capitato.

Hab. Hills north-east of Avontuur, Uniondale Division, Cape Province, 3,100 ft. alt. *Fourcade* 4606 : September, 1932 : *Type* in Bolus Herbarium.

Zuurveld hills south of Bou Plaats, Humansdorp Division, Cape Province, 1,500 ft. alt. *Jeppe :* May, 1933 : in Herb. Fourcade 5014.

E. manifesta is allied to *E. petraea* Benth. (of which I have seen the type, Masson 66 in Herb. Bolus, from the Kamanassie Mountains), but differs in its manifest, not exserted, anthers, in its shorter pedicel and style, in the presence of three bracts which are of a different shape, and in some other features.

PLATE III, FIG. B. (Fourcade 4606).

1, whorl of leaves × 12 ; 2, leaf upper side × 12 ; 3, flower × 6 ; 4, bract × 12 ; 5, sepal × 12 ; 6, corolla × 6 ; 7, stamen side view × 12 ; 8, stamen back view × 12 ; 9, gynaecium × 12.

Erica coronanthera, Compton, (Ericaceae-Ericoideae.) § Arsace.

Frutex erectus, ramosissimus. *Caules* graciles, dense pubescentia floccosa breve cum pilis longioribus glanduliferis intermixtis induti. *Folia* 3-nata, erecto-patentia vel patentia, oblonga, obtusa, sulcata, long. 1·5-2 mm., pilis brevibus glandulosis setaceisque aspera. *Flores* numerosissimi, terminales, 3-4-nati. *Pedicelli* glabri, long. 1·5 mm. *Bracteae* 3, subaequales, subremotae, coloratae, glandulosae, pubescentes, long. 0.75 mm. *Sepala* appressa, membranacea, colorata, aequalia, ovato-lanceolata, acuta, vix carinata, long. 1 mm., marginibus dorsoque glanduloso-pubescentibus. *Corolla* vinaceo-rosea, cyathiformis, long. 1·5 mm., lat. 1·5 mm., glabra, tubo lobisque subaequilongis, lobis suberectis, in siccitate incurvatis. *Filamenta* gracilia, curvata, rubra, antheris aequilonga. *Antherae* inclusae, long. et lat. 0·5 mm., profunde bilobae, inter suas firmiter adhaerentes, rubrae, rugulosae, aristis filiformis curvatis, polline rubro. *Ovarium* sessile, globosum, hispidulum. *Stylus* exsertus, long. 1·25 mm., stigmate capitato.

Hab. Prince Alfred's Pass, Uniondale Division, Cape Province, 2,600 ft. alt. *Fourcade* 5006 : April, 1933 (in full flower). *Type* in Herb. Bolus.

Same locality, 3,400 ft. *Fourcade* 4869 : 1932 (fruiting)

Related to *E. copiosa* Wendl. and *E. setacea* Andr., *Erica coronanthera* is distinguished from these and other species by its copious glandular and floccose pubescence, its strongly adherent anthers, its coloured bracts and sepals, and by other features.

Plate III, Fig. C (Fourcade 5006).
1, whorl of leaves × 12; 2, leaf upper side × 12; 3, flower × 12; 4, sepal × 12; 5, corolla × 12; 6, stamens × 12; 7, stamen side view × 12; 8, gynaecium × 12.

Erica humansdorpensis, Compton, (Ericaceae-Ericoideae).

§ Arsace.

Frutex erectus. *Caules* graciles, subflexuosi, puberuli. *Folia* 3-nata, erecta, linearia, obtusa, sulcata, sparse sed persistente setoso-puberula, long. 2-2·5 mm., lat. 0·3-0·4 mm. *Flores* terminales, 3-nati, et ad apices ramulorum axillares. *Pedicelli* glabri long., 2·5-3 mm. *Bracteae* 3, remotae, juxta medium pedicelli positae, lineares, subaequales, puberulae et breviter ciliatae, long. 1 mm. *Sepala* lanceolata, appressa, puberula, breviter ciliata, long. 1 mm., apice sulcato, obtuso. *Corolla* urceolata roseo-tincta, glabra, diam. 1·5 mm., tubo long. 2 mm., ore leviter contracto, lobis breviter orbiculatis, obtusis, leviter expansis, long. 0·5 mm. *Filamenta* flexuosa, long. 1 mm. *Antherae* ovatae, obtusae, long. 0·6 mm., aristis gracilibus, curvatis, long. 0·25 mm. *Ovarium* globosum, leviter puberulum. *Stylus* crassus, long. 2 mm., stigmate leviter exserto, capitato.

Hab. Clarkson, Humansdorp Division, Cape Province, 700 ft. alt. *J. Thode*, in Herb. Fourcade (Herb. Bolus 21420). June, 1930.

Erica humansdorpensis is allied to *E. Keetii* L. Bolus, but differs in its longer and narrower leaves, narrower sepals, differently shaped corolla with smaller tube and shorter lobes, shorter anther awns, longer style and exserted stigma.

Pate III, Fig. D (Thode in Herb. Bolus 21420).
1, whorl of leaves ×12; 2, leaf upper side × 12; 3, flower × 12; 4, sepal × 12; 5, corolla × 12; 6, stamen side view × 12; 7, stamen back view × 12; 8, gynaecium × 12.

BOOK REVIEWS

HUTCHINSON, J. The Families of Flowering Plants. II. Monocotyledons. London. MacMillan & Co., 1934., pp. x and 243, figs. 107. 20s. net.

The classification of the flowering plants is a subject of interest to the great majority of botanists. Of the innumerable schemes that have been put forward up to the present no one has achieved a general acceptance. The present volume forms the completion of the presentation of the new system devised by Dr. Hutchinson, the dicotyledons being dealt with in the first volume which appeared in 1926.

The present account of the monocotyledons follows the general plan adopted in the former volume, the orders are reduced in size and so become more numerous ; 29 orders of monocotyledons are recognised as compared with 7 in the system of Bentham and Hooker, and 11 in that of Engler and Prantl. The use of the more numerous and smaller orders makes the system at first sight unfamiliar, but many of the changes so introduced are minor ones.

In the system under review Dr. Hutchinson has essayed the task of propounding a scheme that represents the arrangement he regards as forming the phylogenetic development of the monocotyledons. He regards the group as quite definitely monophyletic and as derived from a dicotyledonous ancestor. In the first volume he considered the Ranales as the most primitive dicotyledon type and the monocotyledons are derived from the same source. Such families as the Alismataceae and Butomaceae are looked upon as the most primitive of the monocotyledons and the most nearly related to their Ranalean ancestors. These families already show differences that are regarded as of fundamental importance and which have led to two separate lines of progression in the monocotyledons. The two lines are separated on the form and differentiation of the perianth.

The first has a perianth of which the outer whorl is sepaloid and most often green, the inner may be petaloid or not. Even where both are petaloid they are separate and never united in one structure. This constitutes the subclass *Calyciferae.*

The second line has both whorls of perianth similarly developed, most commonly petaloid, and often united together. This is the subclass *Corolliferae.* A third subclass which is regarded as a development from the Corolliferae has the perianth very much reduced or absent and flowers specialised for wind pollination. These are the *Glumiflorae.*

The Calyciferae start from the Alismataceae, from which two lines of development have taken place. The one shows reduction in floral structure and aquatic habit with the extreme case in Naiadaceae. The other line

comprises land plants and forms a series through Commelinaceae and Bromeliaceae, culminating in the Scitamineae, now termed Zingiberales. The Zingiberaceae are regarded as the highest development of the Calyciferae and as showing a parallelism in development with the Orchidaceae among the Corolliferae, but in no way really connected with them. The isolated families Xyridaceae and Eriocaulaceae represent the ends of less specialised lines in the Calyciferae.

The Corolliferae start from the Butomaceae and present a series of lines of development from the central type of the Liliaceae. From this central type one line has developed towards zygomorphism with its culmination in Orchidaceae. Another with crowded spicate inflorescences has developed through the Palms to Pandanaceae and Cyclanthaceae, which are looked upon as advanced specialised families.

The Araceae represent an individual line as also do Typhaceae. The last are not regarded as primitive or as nearly connected to Pandanaceae. Other lines have culminated in Iridaceae and in Amaryllidaceae, and, through Juncaceae, in Cyperaceae and Gramineae. The grasses are considered as the highest development of the monocotyledons and in this scheme take pride of place over the Orchidaceae.

The attempt to place the orders and families in a strictly phylogenetic scheme and in sequence necessarily leads to some difficulties. An example may be mentioned, Araceae and their allies come between Liliaceae and Alstroemeriales on the one hand and Amaryllidaceae on the other.

In the determination of the phylogenetic lines of development a considerable amount of rearrangement of the plants has been undertaken. Genera are often regrouped, and in some cases families quite reconstituted.

Among the Corolliferae especially the author has rearranged the plants in a way that at first sight appears rather startling. The position of the ovary in the flower is not regarded as a character of first importance. The old, clear-cut distinction between forms with superior and with inferior ovaries is looked upon as an unnatural survival of the artificial Linnean system and certainly of much less value than habit, inflorescence form, and form of underground organs. To take an example, the Amaryllidaceae in their new guise are all plants with scapose umbellate inflorescences with one or more spathaceous bracts, and usually bulbous. Included are plants with both superior and inferior ovaries. The tribes Agapantheae, Allieae and some others from the old Liliaceae are included with the Amaryllidoideae. The Agavoideae and Hypoxoideae of the old Amaryllidaceae are excluded. The resultant family certainly seems to comprise a uniform and similar series of forms. It is perhaps unfortunate and liable to lead to confusion that the old name has to be retained for this quite new group.

A similar association of forms with superior and with inferior ovaries occurs elsewhere. The new family Agavaceae includes the Agavoideae and the Dracaenoideae with the genus Phormium.

Other families are also reconstituted. The Liliaceae have been reduced by the separation of some tribes or groups of specialised forms as separate families, among which are Roxburghiaceae, Xanthorrhoeaceae, Trilliaceae,

Ruscaceae, and some others. The Liliaceae are left as plants with inflorescences never umbellate, regular flowers, and anthers opening by slits.

Of the new families, Ruscaceae contains the genera Ruscus, Semele and Danae. It is difficult to understand why these genera are separated while Asparagus is left in Liliaceae. If Asparagus were also included the new family would be a compact and characteristic group. The connate stamens alone form a separating character at present.

These are the most striking alterations. The others are for the most part necessitated by the rearrangements demanded by the phylogenetic scheme, and the usage of smaller units.

The order Farinosae as constituted by Engler, about which there has been a large amount of disagreement, has been much divided up. The greater part of the constituent families are placed in the Calyciferae, but the Pontederiaceae are closely associated with the Liliaceae. The Restionaceae are placed along with Juncaceae in the order Juncales in the Glumiflorae. This arrangement is open to criticism. The external similarities between Juncaceae and Restionaceae are striking, but on analysis seem rather such as might result from a parallel development and not real affinity. The differences in inflorescence, ovule, endosperm, and in leaf and stomata, together point to an absence of very close relationship.

Incidentally the statement that Restionaceae have flattened or quadrangular stems is one that reads strangely to anyone acquainted with the South African flora.

A consideration of the new arrangement and of the notes on it in various parts of the book gives the impression that the author has been guided in his conclusions by the general form of the plants and by what may be termed a "feeling" for affinity rather than by any study of the details of structure or morphology. In a large number of the new groups the results seem eminently satisfactory, but there are exceptions. In some cases the subdivision of orders or families might appear to have been adopted as a means of avoiding the need for associating plants that have been hitherto grouped together. The divisions of the Helobieae are a case in point.

The volume is certainly one deserving of careful study. While it does not seem at all probable that this system will represent the last word on phylogenetic classification of monocotyledons, in many ways it does clarify the current ideas on affinity, and it should undoubtedly act as a stimulus to further study along the lines of comparative morphology and phylogenetic relationships.

In this volume more details are given for the reasons for the departures from the older schemes of classification than was done in that on the dicotyledons. A very welcome addition is the inclusion of the characters of the tribes in the families and of brief keys to the genera. Unfortunately in the treatment of the large families Orchidaceae and Gramineae this is not done. In the grasses the genera in each tribe are listed, but no details are given for the orchids.

The book is well got up and printed. There are over 100 figures, most of which are clear and satisfactory, though in some of them the details

are neither specially clear nor accurate. There are one or two slips that seem to be the result of haste in the final stages. The statement that Typha is absent from Africa south of the equator is one that certainly needs correction. There is a lack of agreement in Naiadaceae between the characters given in the key and those actually figured. These are, however, very minor points. The book is one of great interest and one that should be read and studied by anyone at all concerned with classification. Whether the reader feels inclined to accept Dr. Hutchinson's conclusions or not, he cannot fail to obtain interest and stimulation.

R. S. Adamson.

The Life-Forms of Plants and Statistical Plant Geography, being the Collected Papers of C. Raunkiaer. Oxford: Clarendon Press. 1934. 35s. net, pp. xvi and 632, figs. 189 (photos 93, text 96).

The life-form of a plant was one of the earliest characters chosen as a basis for classification. With the appearance of the work of Linnaeus and the focussing of attention on flower structure it was overshadowed for a long period, but during the last thirty years, with the spread of ecological interests, the importance of plant form and its relationships to climate have again become prominent.

Of the numerous schemes of classification of life-forms that have been put forward that which has received the most general acceptance and which has been much the most generally applied has been the scheme devised by Raunkiaer for the first time in 1903.

Raunkiaer's original work was, for the most part, published in Danish and in Danish periodicals, and hence has not been very generally available to botanists in other countries. One result has been that his classification of life-forms, which was not only formulated but also tested, has been used by many workers who did not obtain their knowledge from the original sources, but had to rely on short summaries published in other languages. The present writer must admit to being one of these. This has resulted in the overlooking of much of Raunkiaer's work, and unfortunately in the spreading of some misconceptions or misapplications of his views. The publication of this volume, which contains translations of Raunkiaer's papers into English, will render the sources of information generally available and should counteract the misconceptions that have arisen. It will come as a real boon to botanists generally.

The papers included in this volume are arranged chronologically in 17 chapters and cover the period from 1903 to the present. There is also one which has not previously been published.

This sequence of papers is of great interest in many ways. It brings out clearly the growth and development of Raunkiaer's concepts and also demonstrates the wide outlook on plant geography that the author possesses.

The first chapter gives Raunkiaer's original communication on life-forms and the first form of the scheme. The second is a translation of the book in which the scheme was elaborated and its value for plant geography set out. This is illustrated by a number of excellent drawings showing

the essential characters of the various groups of life-form. The inclusion among these of drawings of *Cunonia*, *Pelargonium*, *Babiana*, *Tritonia*, *Gladiolus*, and *Crassula* will help to bring the scheme vividly to a South African and assist in demonstrating its quite general application.

In this chapter the relations of rainfall and temperature, which are the dominating factors in climate as it affects plants, are illustrated by " hydrotherm charts," in which Raunkiaer combined the two factors in one graphic representation.

The correlation of the distribution of life-forms with climate which was commenced in this book was followed up later by a series of papers which form Chapters 4, 5, 7, 8, 9, 12 and 17 of the present book. These deal with a variety of climates and various stages of vegetation. In them the value of life-form distribution as an indicator of climate is fully demonstrated. The distribution is shown to hold both for established vegetation and for pioneer plants on new soils. In Chapter 4 is introduced the conception of a " normal " distribution or " normal spectrum," as it is termed, which can serve as a basis of comparison for any given climate. The concept is followed up and elaborated in Chapter 12.

In Chapter 10 a further aspect of life-form is dealt with. This is leaf-size, which bears such a definite relation to climate. The classification here set out forms an addition to and extension of the general classification of life-forms.

Raunkiaer's work, however, is by no means confined to the classification of life-forms and its applications. He was one of the pioneer workers who set out to obtain quantitative data on the distribution of species within a community and between communities. The concepts of " frequency " and of " areal percentage " are due to him.

The papers here translated deal with his methods and results, and mark the starting point of the statistical method in studies in plant sociology which has been pursued with such vigour since, especially by the European workers. The introduction of these quantitative methods by Raunkiaer has done more than anything else to raise descriptive plant geography to the position of a definite science. Previously, descriptions of the composition of plant communities were vague and very much dependent on the personal factor in the observer. The statistical aspects are dealt with in Chapters 4, 8, 11, 16, and 17.

In addition, there are papers dealing with soil acidity and its relation to vegetation (Chap. 14) and detailed studies of single plants (Chaps. 3 and 15).

While much of the work carried out in demonstrating and elaborating the ideas put forward by Raunkiaer was carried out on the vegetation of the cooler and even arctic regions of the northern hemisphere, this is by no means always the case. Moist tropical climates are treated and also the Mediterranean climate, which in many ways is so similar to that of the south-western Cape.

However, the basal concepts are universal in their application, and the treatment is so clear that, in spite of the sometimes unfamiliar examples

that are chosen as illustrations, the interest and importance of the contributions must be apparent to anyone interested in plant geography.

The issue of the volume originated with a committee in Denmark who felt that the work of Raunkiaer had not received the attention its intrinsic importance deserved, largely owing to language difficulties and to the relative inaccessibility of some of the publications in which it appeared. All botanists must be grateful to them and to the Clarendon Press for producing the present volume, which renders the work so easily accessible.

The translation has been carried out in the main by H. Gilbert-Carter. Two of the papers are translated by Professor A. G. Tansley and one by Miss A. Fausbøll. Professor Tansley has acted as general editor and contributes an introduction. These persons must be congratulated on their work. The book as a whole does not read like a translation. The papers have been translated literally as far as possible and left to speak for themselves. Very wisely no editorial notes or comments have been introduced.

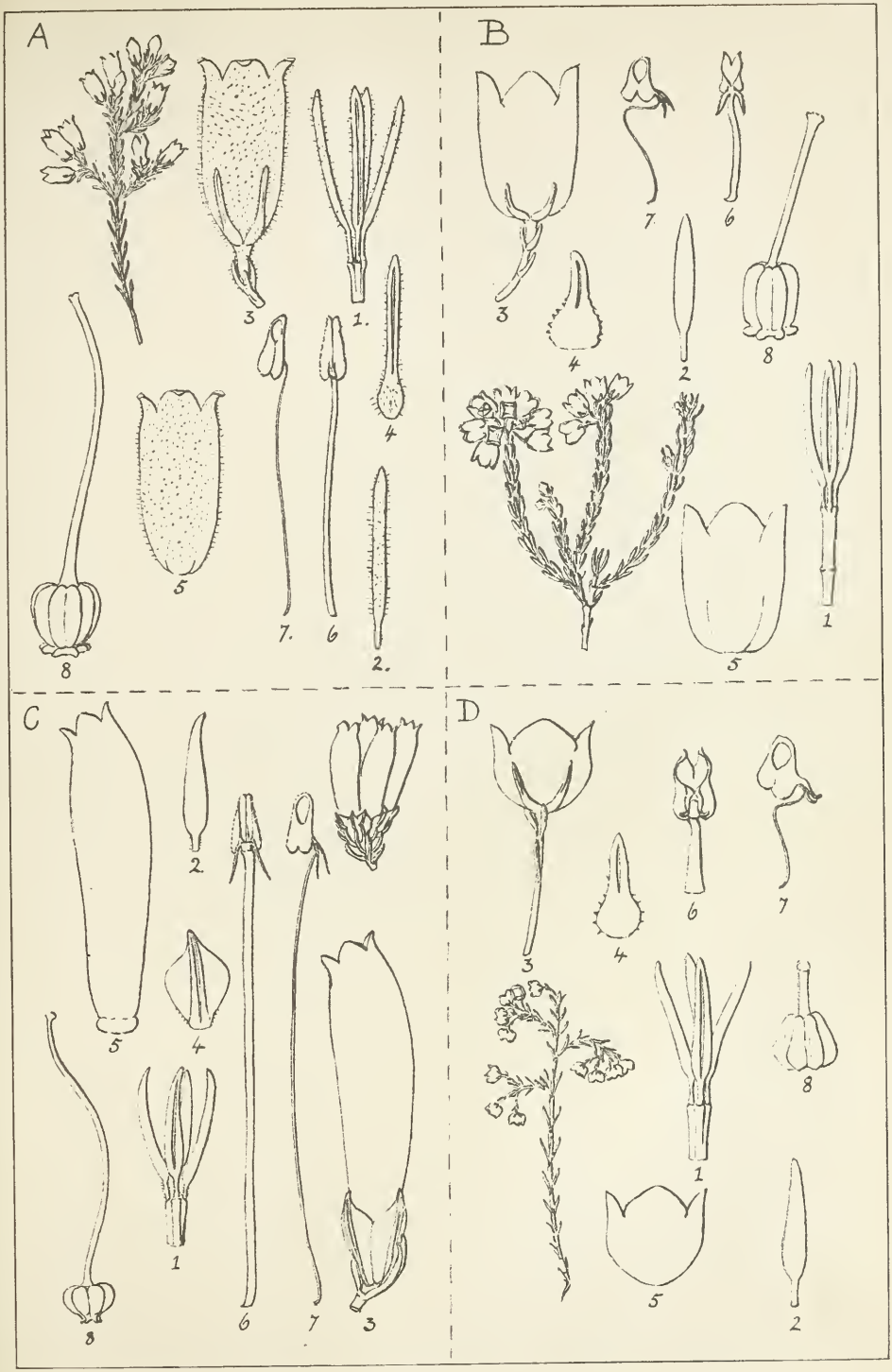
The book is printed in the excellent manner associated with the name of the Clarendon Press and is very fully illustrated. Both the line drawings and the numerous photographs are of excellent quality and very well reproduced.

The volume is one that should be read and studied by all botanists, and most assuredly no botanical library can afford to be without it.

R. S. Adamson.

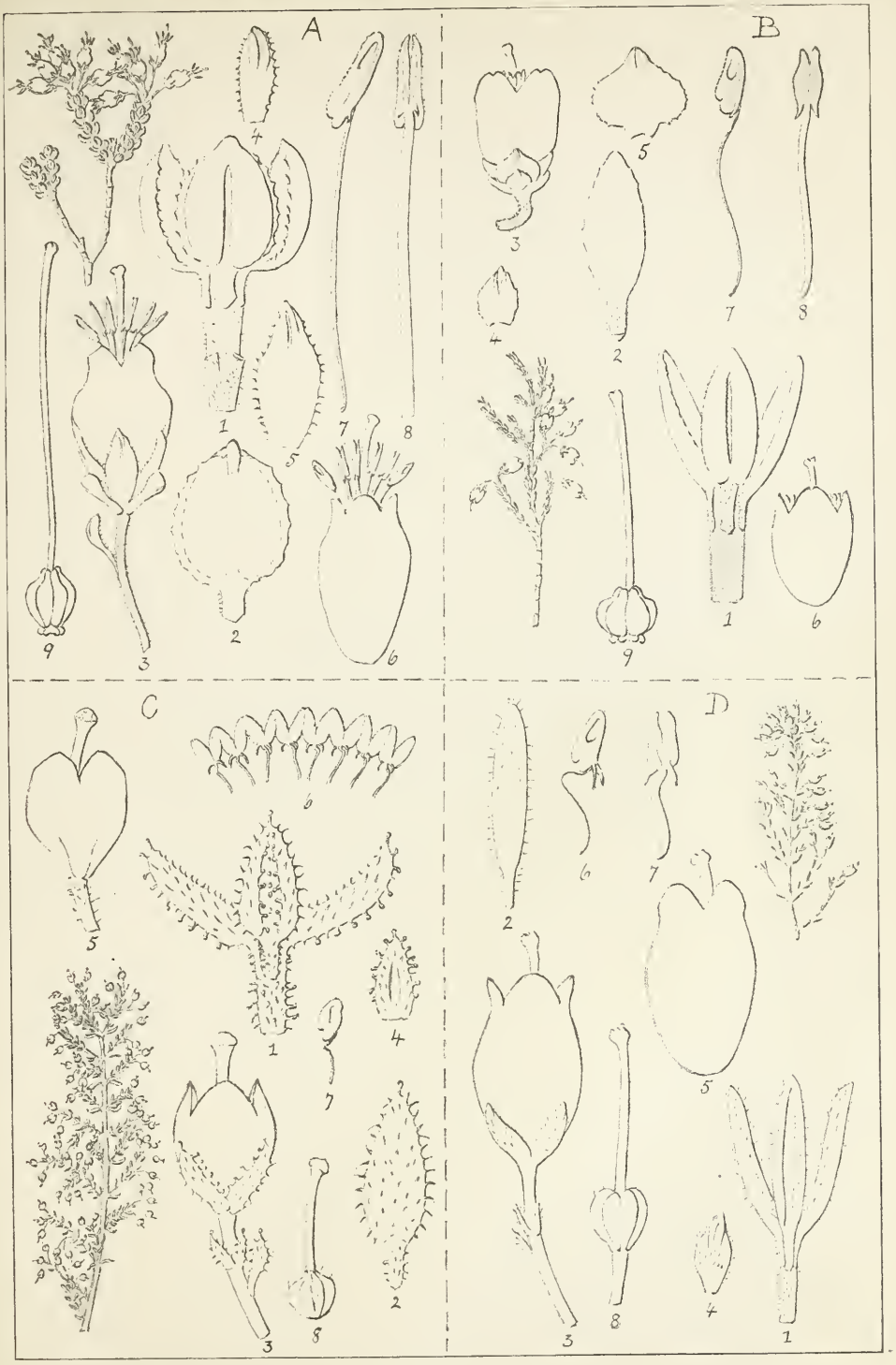
Del. W. F. Barker.

A. Hessea karooica Barker. *B.* H. unguiculata Barker.



Del. W. F. Barker.

A. Erica heleogena Salter.
B. E. capensis Salter.
C. E. Galpinii Salter.
D. E. eburnea Salter.



Del. W. F. Barker.

A. Erica Krigeae Compton.
B. E. manifesta Compton.
C. E. coronanthera Compton.
D. E. humansdorpensis Compton.

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SOME PROBLEMS PRESENTED BY SOUTH AFRICAN GRASSES AND GRASS COMMUNITIES.

By John Phillips.

Introduction.

The grasses and grass areas of South Africa for a long time have been of interest to the botanist. They have attracted, too, the attention of the agriculturist, more especially the agriculturist concerned with crop production. During the last few years, however, an additional interest has been shown in our grasses and in our grasslands of various types, by reason of the realisation that much of the future progress of South African agriculture lies in the direction of the proper development and use of our pastoral resources.

Official support of the policy of conservation and improvement of our pastoral resources has led to an increased activity in grass and grassland investigation, by Government and University biologists pure and applied ; this activity is likely to bring to light much information of scientific and economic value. Fortunately, work accomplished by investigators such as Stapf and Stent in *systematics*, Bews and Pole Evans in *ecology*, Pole Evans, Pentz, T. D. Hall and others in *pasture and veld management*, and A. Bosman and his associates in *animal husbandry* goes far toward laying a sound foundation for research and large scale experimentation still to be attempted.

For several years certain problems in grass and grassland ecology and management have drawn the attention of those working at the Botanical Research Station of the University of the Witwatersrand, at Frankenwald in the highveld, 14 miles north of Johannesburg. Consideration of some of these problems and of those presented to me during various reconnaissances in the main grass regions of South Africa, taken together with impressions gained from reconnaissance in Tanganyika, leads me to the conclusion that a brief and simple survey of some of the outstanding problems facing investigators in this field of biology, is likely to prove helpful to younger workers.

Some of the Important Problems Presented.

In outlining some of the important problems presented by our grasses and grasslands, I make no attempt to enter into detail regarding past work, or technique to be applied in the future ; I content myself with stating the problem, its bearing, and my views regarding general lines along which its solution should be approached.

(1) *Systematics.*

Stapf in his monumental work in the " Flora capensis," Stent in her various generic and specific accounts, Bews in his two books on grasses, Hubbard of Kew in his published and unpublished investigations, E. P. Phillips in his monograph on the genera of South African grasses, and Goossens in his description of some grass species have helped greatly toward our possessing a good working knowledge of the taxonomy and systematic botany of our grasses. At the same time, it would be admitted, I am sure, by one and all of these investigators that in *detail* much is still obscure regarding relationships among families, sub-families, tribes, genera and species. Concentration of attention upon certain important genera—important either on account of their value in pasture and veld management, or because of their playing a fundamental role in veld ecology—has shown how inadequate is our knowledge of the species and of the varieties making up such genera. The examples of Digitaria brought to our notice so clearly by Pole Evans and Pentz, Setaria and Eragrostis suffice to illustrate to anyone *au fait* with the elements of knowledge regarding our grass flora, the truth of my statement that we know still too little of the systematic botany of our grasses.

It is worth stressing that in addition to the obvious importance of knowing more clearly the species within genera, is the basic need of being able to differentiate important varieties of the species. It is becoming more and more definitely established in this country as well as elsewhere, that *varietal* or *strain* characteristics play a far-reaching part in determining the suitability of a particular grass for a particular object of pastoral management. Anyone in South Africa requiring to be convinced of this, should visit some of the varietal plots and experiments established at Pretoria by Pentz under the direction of the Chief of the Division of Plant Industry, Dr. I. B. Pole Evans.

While a considerable amount still could be done by systematists working in herbaria overseas and in this country, it becomes increasingly plain to anyone observing, collecting, and experimenting with our grasses in the field, that systematic work to be of the first value and service should be conducted upon plants in the field. Features clearly

discernible to the observant eye in the field, frequently disappear wholly or in part when the plant is removed, pressed and dried, poisoned and mounted. I take this opportunity of referring to the problem mentioned in the next section—leaf and stem identification at all times of the season and under all conditions of the weather—in support of my view that the systematist must have ready and frequent access to the living plant, and to the living plant under natural conditions of the habitat : a cultivated living plant may show appreciable morphological differences from one of the same species growing under natural habitat conditions. If the systematist is to be of real aid to the collector of strains for pastoral experiments, and to the ecologist wishing to attempt an explanation of habitat and community features conditioning occurrence or dominance of strains, he must accompany these field investigators upon their reconnaissances, and must, *in situ*, sketch, colour, and describe from the living plant. Removal of living parts to the experimental plots at the base station, growth of these under known conditions of treatment, and ultimate re-description of the strain as there developed, would provide against the possibility of the single natural habitat description being made applicable to a single set of habitat conditions only.

In brief, the problem of differentiation of species and of strains must have added to it the conjoint one of enabling systematists with a field sense, to visit our grasses in the field. Obviously many practical obstacles have to be overcome : provision of financial and travelling facilities, and the selection of systematists with the flair for field work being perhaps the most difficult to surmount. As regards the first—grants for travelling could be made to Government and University systematists ; the second could be overcome by our Universities setting their faces in the direction of training systematists in the field as well as in the laboratory and herbarium.

(2) *Identification of Grasses at all times.*

In ecological and pastoral management practice it is necessary to know the grasses—and often the sedges and other associated flowering plants—at all times, under all conditions of the weather, and in the absence of flowers. While this becomes possible, with careful practice, within a limited region, over several years, it is found that the investigator accustomed to a given set of species and strains on a restricted series of soils under a given climatic complex, requires practice before he is able to identify without flowers the same species growing upon different soils under a somewhat different climatic complex. His difficulties are accentuated if not only the soils and the climatic complex, but also the species be different.

At the Research Station, Frankenwald, for example, it has been found possible for students with some experience of the seasonal change in the appearance, texture, odour and other characteristics of the grasses of the veld, to identify these rapidly and accurately without flowers, under all conditions of the weather. The same students, on proceeding to a station at Drylands, near Pretoria, showing a similar flora upon a somewhat different soil and under somewhat different aerial conditions, find it requires careful practice before some of the kinds more difficult of identification, could be referred to the correct genera and species.

From attempts that have been made to list and arrange in the form of a diagnostic key, the distinguishing characteristics of stem and leaf—and root in certain instances—it has become clear that while some of these are definite and always reliable, others are variable with seasons and with precise weather conditions obtaining. Temperature, humidity, evaporativity, and transpiration rate appear to be of first importance in altering the general appearance of foliar organs during the "green" season: during the period of "dryness" of the stem and leaf, temperature, humidity and evaporativity play some part in altering the general appearance. Each season appears to require the utilising of characteristics of both permanent and seasonal or evanescent nature—that is a *seasonal* identification key is necessary. As regards alteration of general habit due to expanding or rolling of leaves, precise ocular characteristics of hairs, etc., it has been noted that change in humidity—due to increase in water vapour or falling of rain—is especially powerful in bringing about rapid, and sometimes somewhat disconcerting, changes in the general appearance of the grass. Without attempting anything approaching a full list of the characters found of either permanent or seasonal or periodic importance in identification, I give the following as examples: (i) nature and pattern of the leaf and stem striations or other markings, if any; (ii) nature of hairs on leaf and stem and change of these with season and weather; (iii) ligule—form and other characteristics; (iv) nature of leaf margin; (v) venation—the precise characteristics, and the nature of the mid-rib; (v) nature of expanded, semi-rolled or folded, and completely "closed" leaf—and relationship existing between these states and the weather; (vi) form of apex and base of leaf; (vii) nature of stem; (viii) nature of base of stem—how protected, whether hairy or not, odour, etc.; (ix) odour and taste of leaf and stem; tasting of grass is to be done with care and not too often, as it is suspected that over-frequent tasting, with often associated inhalation, lays the taster open to infection by hay-fever, and possibly certain bacterial diseases; (x) colour, texture, odour of roots, and in some instances, taste of roots.

It is proposed to publish for some 30-40 species occurring on the Re-

search Station, Frankenwald, seasonal and weather keys to the grasses. What is required, is that workers in their own regions should so familiarize themselves with the stem, leaf and root characters over the seasons as to be able to produce local keys, In this way, not only would all the important types of veld and region be covered in due course, but also a general comprehensive comparison of experiences, species for species, strain for strain, would be possible. University departments would find this excellent practice for students, and one capable of separating observant from rule-of-thumb prospective botanists.

(3) *Experimental Taxonomy, Genetical Cytology and Breeding.*

With the objects of separating strains, isolating true breeding species, and selecting really satisfactory material for given pastoral purposes, it is distinctly necessary that the methods of the experimental taxonomist, the cytologist, and the practical scientific plant breeder should be brought to bear upon the more important of our grasses. Digitaria, Setaria, Chloris and Cynodon alone would provide work for specialists in these lines for many years.

There can be little doubt that the subjecting of some of the so-called species of some of the very plastic genera to experimental growth methods —such as those utilised by Hall and Clements (1923) in their phylogenetic investigation of certain North American dicotyledons—would return instructive information as to the relative fixity or otherwise of these.

Additional evidence regarding factors responsible for the production of *habitat forms* or *ecads*, among the more important grasses would thus be made available. Such work would require to be carried out not only at a central base station, where experimental cultures under controlled edaphic and aerial factor-complexes could be established, but also in the natural habitats of the kinds selected—gradations of change in important factors or complexes of factors being arranged *in situ*. Herein it is that systematist, morphologist, geneticist and ecologist could join in co-operative work.

With reference to the cytological genetical work—certain of the genera (again it is in place to mention particularly so important economically a genus as Digitaria) require careful investigation of their chromosome characteristics, with the objects of throwing light upon their possible ancestry and possible relations within the genus. Cytological work, to be of the first value, must be conducted in touch with selection and growth work by the experimenter in growth and in management of the species and strains. A beginning has been made with the genus Digitaria by Young and Crocker (1933), and this work is to be

continued with a number of the more important strains. A species loudly crying for genetical study supported by experimental taxonomic work is *Themeda triandra*, "Rooigras": a grass showing probably many hundreds of strains and ecads, and economically present in forms suitable for management ranging from heavy grazing, through very light grazing, to hay production. As regards cytological work on Digitaria, a further feature of interest therewith is the non-seeding shown by so many forms and the weak to strong seeding ability shown by others; possible correlation of cytological features and seeding capacity is being sought.

Practical plant breeding methods according to the most up-to-date technique have yet to be applied to our veld grasses. Much useful preliminary work has been done by the Division of Plant Industry at its grass stations at Pretoria, but to this must be added more precise work. Real progress in this important and difficult aspect of grass work is likely to be delayed until the problems of seed production mentioned under (5) below, have been cleared up considerably. Important material awaits the plant breeder in such genera as Panicum, Echinochloa, Brachiaria, Setaria, Chloris; Cynodon and Digitaria, owing to seed production peculiarities, are likely to present particularly interesting material.

It must be emphasized that necessary as experimental taxonomic, cytological and breeding investigations are, they would lose much value were they to be conducted out of touch with the work of the practical collector, grower, and pasture manager.

(4) *Roots and Rooting Habits.*

If it be stated that we know very little about the aerial portions of our grasses—whether it be in terms of their structure, habit, physiology, or ecology—it could be argued that we know just about *nothing* regarding the roots. Some attention has been paid to the structure of certain grass roots by Henrici (1929) and Goossens and his associates (1933, 1934), while rooting habit has been investigated by Murray (1934) and by Murray and Glover (1935) at the Botanical Research Station, Frankenwald. It remains, true, however, that the beginning of a systematic investigation of root morphology, anatomy, physiology and ecology remains to be made. It is plain that a knowledge of the nature and functions of the roots would go a long way toward providing a better understanding of the behaviour of aerial portions, and of the ecology of communities. On the purely economic side, it is being found more and more difficult to manage veld in the absence of knowledge of the growth, reserves, and stratification of the roots of the more important grasses.

A beginning has been made with root stratification studies; to return data of any general utility this work should be taken up in the same species in the more important soil types in the same climatic region, and in the same and other soil types in different climatic regions. Additional important species should be included region by region. Such stratification studies would return information regarding the respective depths of rooting, nature of root competition for water and solutes, relationship between rooting phenomena and *successional* characteristics of grasses in given communities, and relationship between methods of grass management and nature of roots and their food reserves.

Side by side with stratification studies in communities of different successional status, and different management history, should proceed experimental investigation of the physiology of roots—more especially in terms of water relations and storage and utilisation of reserves. Growth phenomena in roots, too, require study, and correlation with growth phenomena in aerial portions.

Root *bisect*—i.e. stratification—investigations on the basis of the methods of Weaver and his associates, but with modifications to meet local needs, have so far indicated the efficiency of the method of exposing roots and rootlets by means of a spray of water of controllable strength from a locust foot pump, followed by dissection of the roots and rootlets from the soil by means of needles. Scaled drawings and photographs, together with measurements and detailed descriptions of the roots and rootlets, are then made possible.

One of the most "knotty" problems in grass ecology is the obtaining of an impression of the depth and nature of the roots of grasses without disturbing the soil, and thus permitting a second investigation for sake of comparison, at a later date. The growing of grasses in containers, with subsequent examination, does not meet the case. Up to the present the most satisfactory of several admittedly inefficient methods is *either* to examine several representatives of a given species at a given date, and several different individuals as closely as possible resembling in size and vigour and habitat conditions the first set, at a later date; *or* to plant a large number of specimens of a given species, in a homogeneous soil, and year by year to examine certain of these, leaving the remainder to develop until required.

(5) *Seeding Phenomena, and the raising of Grasses from Seed.*

While a large number of our grasses has been grown from seed, this, for the greater part, has been done on a very small scale only. Our

scientific and practical knowledge of *when* to collect seed, *how* to collect and store it, and *when* and *how* to sow it is meagre. Some of our grasses appear to produce abundance of seed annually, others appear to bear abundantly at either longer regular or irregular intervals, yet others appear to produce little or no seed. From the points of view of the ecologist concerned with veld successional problems, the manager of artificially established and naturally established pastures, and the prospective collector and tester of seeds of our grasses, it is essential that a systematic *phenological* survey of flowering and seeding phenomena should be commenced. Such a survey should provide for the collection of data pertaining to periods of seed production, periods of ripening, periods of dispersal of seeds, periods required for adequate germination, dormancy characteristics of different species and how dormancy may be either prolonged or reduced. Methods of collection, cleaning and testing of seed on a large scale should be investigated, so as to select for each of the main species the most efficient and the least expensive method. Methods of soil preparation and tending, to produce the best germination, establishment and growth, too, require experimental study.

Some of these problems are being studied by investigators in Government service, and are receiving attention from a worker upon the Botanical Research Station, Frankenwald—Mr. T. Barenbrug, who has had extensive experience with work of this kind in Europe ; but much requires to be done. The subject lends itself to student investigation over a period of several years, and hence could be taken up by our Universities.

(6) *Growth Phenomena.*

It has been indicated in connection with the problem of root growth that we require more information regarding season, rhythm, and nature of growth in grasses. Several small-scale observations have been made by means of auxanometers and direct measurement, but species by species, community by community, growth phenomena over the relevant periods of the year require to be investigated on a systematic basis and on a liberal scale. In connection with problems of when to graze lightly or heavily, when to mow, when to fertilize with chemical and organic fertilizers, when to plant for most rapid growth and best competition with weed growth, knowledge regarding rhythm of growth is a basic need. Specific differences in terms of periods of maximal growth may be of the first importance when it is desirable to encourage one set of grasses and to retard or eliminate another.

Much may be done by direct observation and measurement of selected

individuals of the required species, frequent—sometimes daily—attention being a necessity for success.

(7) *Succession Details.*

While Bews has done a very great deal to present a general picture of successional features in grassland in South Africa, with special reference to Natal, it is perfectly evident to any student of grassland ecology and management that every region, every district, every community type requires careful investigation before reliable details of direct utility to ecologist and manager of veld are available. I have given some outline elsewhere (Phillips 1934; 1935; 1935A) of the many difficult features presented the student of *succession*, *development*, and the *climax community*, hence it is not necessary to do more than refer to the highly complex nature of this interesting and important phenomenon, and to emphasize that in a country of the diversity of micro-climates and soils shown by South Africa, many features in grassland succession by no means have been investigated. Fundamentally important questions scientifically and economically include these: What is the climatic climax for a given region? What are the principal stages in the successions in a given region? How may such stages be accelerated or retarded in their development toward the climax? What are the results of attempting to control the climax at a given point, according to a given season and method? What bearing upon *successional retardation* or *acceleration* or *deflection* (vide Phillips 1934), have prevailing methods of grazing, soil cultivation, and burning of vegetation? While our knowledge of the aerial portions of important species within *successional* and *climax* communities is all too meagre, it must again be emphasized that we know just about *nothing* regarding the root changes accompanying *successional* changes.

Within each principal region, it is strongly desirable to investigate the *successional* features and tendencies, and to do this on an experimental basis—in terms of protection, subjection to controlled grazing, controlled seasonal firing, and the like.

Although much of this work may appear of purely academic interest—it is the duty of the ecologist to stress that in reality it is the foundation upon which the success of the student of pastoral control most surely rests.

(8) *Cyclic Phenomena.*

Cyclic phenomena in Nature—sunspot cycles, rainfall cycles, with resultant growth cycles in vegetation—have received much attention

of recent years in the United States, and to a lesser extent in Europe. They certainly appear worthy of some attention in South Africa. The recent flush of growth in grass communities in many portions of the Union, following two seasons of somewhat higher rainfall than those preceding, has been an instructive phenomenon. In many parts *Themeda triandra* or "Rooigras" has shown a remarkable capacity for reappearance as a dominant over areas where for some years it has been but poorly represented, while the appearance in certain parts of tall Cymbopogons and Andropogons and other grasses of the stages leading to a Scrub climax is most interesting. Attention is being paid to possible correlation among sunspot cycles, rainfall cycles and peculiarities in the growth-rings ("annual rings"), in certain deciduous indigenous trees of the Transvaal highveld, with the object of seeing whether the record of growth-rings in such trees is in any way an index to past moister or drier cycles, and whether there be any remote possibility of future cycles being predictable on grounds of the evidence of the past. If investigators in different regions of the Union were able to agree upon the selection of a common indigenous tree species widely distributed—e.g. *Acacia caffra* or *Zizyphus mucronata*—and were to follow common methods in attempts at correlation, a really considerable body of proof *for* or *against* the possibilities mentioned, would be obtainable. Dr. A. E. Douglass, a pioneer investigator of cyclic phenomena as indicated by growth-rings in Sequoia and other long-lived tree species in North America, and by certain European species, recently has founded a society in America for investigation of such phenomena, and is publishing a journal presenting the results.

(9) *Fire: Its Influences in Grassland Vegetation.*

I have published elsewhere my views regarding the role of fire in vegetation in South and East Africa (Phillips 1930), and added experience since the writing of that contribution makes me all the more inclined to support the views put forth therein. Fire, according to the species of grasses concerned, the successional rank of the community, the vegetation region, the season of the year, the nature of the season in terms of moisture and temperature, and probably other conditions presently not fully understood, may do either considerable harm or may do much good. Staples (1926; 1930) has shown the great importance of season of burn upon Themeda; experiments being conducted since 1931 at the University of the Witwatersrand, Milner Park, in Themeda communities go to support in general the experiences of Staples: burning at one season may encourage growth and development to dominance of "Rooigras," whereas at another, burning may be direct cause of

either considerable reduction or complete disappearance of the species. Other important dominants possibly present similar responses, but little or nothing is known about them.

Seasonal firing, with and without the additional feature of earlier or later grazing of the fresh growth springing up on the burned area, requires far more detailed regional and community investigation than it has received. From evidences being produced from consistent observation and from general experience, it is tolerably clear that fire must continue to play an important role in veld management in South Africa, provided it be more fully investigated, and provided it be used with considerable care as to season. It must be stressed that the problem is not one purely of season of firing, but rather one of season of firing and related season of grazing of the burned area ; nature of the grazing, the weather conditions obtaining at the time of grazing, and the general nature of the season are likely to introduce important complications.

Carefully conceived and uniformly executed experiments upon seasonal firing in different communities, in communities at different stages, in different districts, and in different regions require to be laid down by Union investigators working in collaboration. In the first instance, the complications springing from grazing of the burned areas should be left out of consideration, special arrangements being made for these later.

At all events, our present knowledge indicates that indiscriminate firing is not much more harmful in grassland management than is indiscriminate with-holding of fire.

(10) *Grasses and Grass Communities in relation to Grazing and Browsing.*

Without attempting to deal with the manifold problems of the grazier and the student of animal husbandry, it is necessary to refer briefly to the problems set by the influence of grazing and browsing upon grassland communities. It frequently is stated by the layman that heavy or " over " grazing is responsible for denudation of the soil, but it is less often realized that over-grazing actually often has precisely the opposite effect : acceleration of the growth of the woody elements of the flora by removal of the competing grasses. This brings me to a point that might well have been made under the heading (7) dealing with *succession*—in my opinion it is extremely doubtful whether in the Union more than rather local areas in the colder regions of the Free State and Southern Transvaal—e.g. in the Standerton area—truly are *climax* grassland. I base this suggestion upon the sometimes relict, sometimes very abundant woody elements—constituents of a Scrub community—to

be found in almost all the other regions rich in grassland. Over-grazing reduces the grasses ; grass reduction means less competition with the shrubs and small trees for moisture and solutes, and the impossibility of grass fires normally destructive to the Scrub ; Scrub kinds, therefore, increase, and in time build up a more or less closed *climax*. Any area within a region in which development is to Scrub, on the other hand, tends to become covered with coarser grass, with perennial herbs and shrubs, if the grazing to which it is subjected be insufficient to keep the succession at a suitable grass stage.

Early grazing may spell the reduction or elimination of certain early species, whereas late grazing may reduce or eliminate in time later species : therefore the phenology of the species must be studied in relation to the grazing system proposed.

Light grazing of a community may mean highly selective taking of certain species, and more-or-less complete rejection of others, whereas the same community, if more heavily grazed may have a far greater number of species taken.

Numerous other examples of plant - animal interrelations could be cited, but sufficient has been said to warrant the conclusion that our grasses and our grassland communities require very careful experimental study in relation to the kind of grazing to which they are subjected. Browsing animals, it is to be remembered, may have profoundly different influences from grazing animals.

Attempts to throw light upon some of the many problems set by the animal-plant relationship are being made by the Government authorities concerned, by the Agricultural Adviser to African Explosives and Industries, by the Faculty of Agriculture at the University of Pretoria and the Botanical Research Station, Frankenwald.

(11) *Zoo-biotic problems.*

While the zoologist naturally is loth to pay attention to zoo-biotic problems set by domesticated stock, it is not too much to expect him to take some interest in the problems connected with important indigenous animals. So far there has been a curious lack of enthusiasm on the part of most zoologists to take up any of these problems.

It is sufficient for my purpose to refer to termites and to smaller rodents—rats and mice. Termites of various species play a fundamentally influential role in grassland vegetation in South Africa. Among them are forms distinctly beneficial through their soil improving, soil aerating, organic matter producing activities ; among them are distinctly harmful forms—such as the Hodotermes—responsible for much grass-cutting during the drier seasons of the year ; some forms are alleged to take

heavy toll of the grass seed in lean years. At all events, our knowledge of these helpful and harmful forms is all too scant, and our knowledge as to how to control the harmful forms, on a large scale, is negligible. Zoologists with a flair for ecological work are earnestly required for this class of investigation. The smaller rodents in some seasons eat grass roots, grass seeds, and help in dispersing seeds ; they also, in their colonies, appreciably open up the soil. In areas where they are abundant, their study is long overdue.

(12) *Indicator significance of certain communities.*

Clements (1920) has developed the concept of plant indicators, and I have dealt with principles and details for indicators in the Knysna forest region (Phillips, 1928 ; 1928A) ; so far as I am aware, no published information regarding indicator communities in grassland is available for South Africa.

In grassland, indicator communities should prove of the greatest possible utility in pointing to the past history of development, and to the future possibilities of management. From our experience upon the Botanical Research Station, Frankenwald, it is possible to select for general working purposes communities, pure or mixed, that throw light upon :—(i) Past history of the area, in terms of disturbance or management ; (ii) future possibilities of the area in terms of management ; (iii) successional status of associated vegetation ; (iv) important edaphic conditions, such as higher, medium, or lower moisture content ; presence of an impermeable pan below the surface ; whether the soil has been disturbed by ploughing or other form of cultivation, and at what approximate date in the past.

Region by region, soil type for soil type, community for community, such indicator work is required ; not only would this return most valuable information for the student of pastoral management, but it would provide fascinating material for the ecologist.

Connected intimately with the concept of plant indicators is that of *phytometers*, again due to Clements (*vide* Clements and Goldsmith, 1924 ; Clements and Weaver, 1924) ; a phytometer being a " standardized " plant, the responses of which (in terms of transpiration, amount of photosynthate, growth, anatomical and morphological features, general phenology, etc.) are measured in a given habitat. (For South African work on *phytometry*, *vide* Phillips, 1925 ; 1927). As grasses grow so rapidly, are often so very sensitive in their responses to light, humidity, soil moisture, chemical solutes and the like, it has been suggested from time to time that they should prove useful phytometers. So far the work

done by two of my students—Mr. H. Gillman and Miss A. Brownlees—upon several species of Digitaria (*D. valida v. glauca* Stent ; *D. seriata* Stent, being the " Pretoria Small " and the " Kuruman " strains of Digitaria respectively), has shown some of the great dificulties connected with the use of stoloniferous plants as phytometers. As control phytometers have to be kept in containers which have to be sealed against rain and against loss by evaporation, stoloniferous grasses fail to grow adequately, owing to the impossibility of their stolons finding their way out to the light, and then back to the soil within the pot. Work on grass phytometers, however, is well worth further attention in the light of the rapid growth of the material.

Phytometer cultures in either unsealed containers, of large size, or in the open ground, are likely to prove useful for purposes of rough comparison of sites. Controlled phytometers, made up of non-stoloniferous grasses, however, are worthy of trial.

One of the objects of referring to the difficulties encountered in attempts to make phytometers from stoloniferous grasses, is to indicate how complicated is the problem of obtaining adequate data regarding the water relations of stoloniferous grasses, water relation technique depending so directly upon the sealing of containers against rain and evaporation.

(13) *Special methods of investigation.*

Grasses in their growth-forms, nature and rapidity of growth, and ecological characteristics present many problems as to methods of investigation likely to prove productive as well as workable in practice on a large scale. Probably in the sphere of community investigation, popularly known as " grassland analysis," this is more definitely brought out than in any other. Methods of analysis productive of satisfactory results within a reasonable period in forest, scrub or " fijnbos " (macchia) communities, in most instances usually are not applicable, without considerable modification, to communities of grass. So much is this truth forcing itself upon me, that for some time my students and I have given serious attention to the selection of methods possible and efficient for given purposes in grass communities ; the further we proceed, the more we realise that even the very best of methods so far available, are by no means satisfactory. In one method, efficiency may be satisfactory but the possibility of carrying out the method as a routine one, on a large scale, is out of reasonable consideration ; in another, where speed is satisfactory, one or other technical feature leaves something to be desired. It is furthermore clear that the method of analysis selected must to a great extent depend upon the objects hoped to be attained ; indiscriminate

application of so-called " standard " method not only is unscientific in principle, but is likely to return little useful at the end of many days or weeks of hard field work. Investigation is proceeding, with special reference to the peculiarities of our grassland communities in terms of growth-forms of grasses, espacement of individuals or groups, abundance of plants other than grasses, nature of the community, and precise objects of the experiment and of the analyses. So far, depending upon the foregoing *inter alia*, we are finding our own modifications of Raunkiaer's analysis circle, the density-cover list quadrat, the camera-chart quadrat, and the photograph-quadrat effective up to a point. Pantographic methods so far attempted appear cumbersome and liable to variable error, but probably hold within them the basis of modifications really rapid and efficient.

Plant photography is by no means an easy aspect of photography, but the photographing of grasses under field conditions is certainly one of the most trying aspects of this difficult subject. Critical focusing, critical use of apertures and exposures, and careful selection of filter and of angle often are ineffective in giving depth and detail where these are essential for purposes of scientific record. Stereoscopic methods have something to commend them, and are being tried with some success by a former student and colleague, Mr. J. D. Scott, now of the Division of Plant Industry.

Problems in physiology technique have been mentioned under (12); these require earnest attention if any real value is to be yielded by grasses grown in containers.

Habitat factor analysis—all too frequently left out of account in grassland research, because it is thought that aerial conditions are so similar as to play no important role, and because chemical analysis of soil alone is considered as being of any importance among the edaphic conditions—presents some special problems as to methods likely to provide information precisely bearing upon factors regulating responses in the grasses.

Conclusion.

From the foregoing outline of problems, it is clear that grasses and grass communities in South Africa provide material to set investigators, with various interests, thinking hard, and experimenting with minds receptive for suggestion emerging from increased experience. Thus this field of investigation, in addition to adding much information essential to the solution of our national pastoral and erosion problems, provides ample scope for the student of pure science, and for the investigator

who at the same time is interested in experiments in scientific, more especially, botanical education.

Summary.

Important problems are mentioned as existing in the following :— Systematics ; identification of grasses at all times ; experimental taxonomy, genetical cytology and plant breeding. Ecology of roots of grasses. Seeding phenomena, and the raising of grasses from seed. Phenomena of growth, with reference to methods of pastoral management. Successional features, details, and principles, community by community, region by region. Cyclic phenomena, such as growth-cycles, sunspot cycles, and rainfall cycles. Fire, and its influences upon grasses and grass communities. Grasses and grass communities in relation to grazing and browsing by domesticated stock. Zoo-biotics, especially rodent and termite problems. Indicator significance of certain communities. Special methods of investigation in grassland :—ecological community analyses ; photography ; and habitat analyses.

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A PRELIMINARY STUDY OF THE ROOT DEVELOPMENT OF CERTAIN SOUTH AFRICAN HIGHVELD GRASSES.

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While engaged upon investigations into the response of natural grassveld to fertilizers under conditions of controlled grazing at the botanical research station of the University of the Witwatersrand, the writers decided, at the suggestion of Professor John Phillips, to commence a study of the root systems of the different grass species occurring within the experimental areas. The difficulty in obtaining information on the grasses from this aspect, made it necessary to make a preliminary study of some of the more commonly occurring species, and it is the object of this paper to record the results of this study and to describe the technique employed.

Procedure.

The procedure adopted in making these investigations is based upon descriptions of the study of the root development of plants by Weaver (1919 and 1926), who has carried out extensive investigations in the United States.

A pit is dug near the plant to be studied so that a clear-cut working face of sufficient area is exposed to include the estimated extent of the root system. The face is then marked out in 6-in. squares with string stretched between wire pegs. Excavation of the roots is then commenced in the square adjacent to the base of the plant, and these roots are charted to scale on squared paper: a scale of $2'' = 6''$ is found most convenient. The remaining squares are then excavated and charted and the working face increased in size if necessary, until finally a bisect of the entire root system is obtained. As the work progresses, notes are made upon the frequency of branching and any other marked characteristics of the roots, and also the types of soil encountered at different depths.

Since the grass roots studied were mostly very fine and delicate, and the soil hard and dry, various methods of excavating the roots had to be tried before satisfactory results could be obtained. The first method tried consisted of picking away the soil with thick wire implements sharpened to a fine point, but although these were found useful for digging away superficial soil from the coarser roots, they were too clumsy for

working with the finer ones and ordinary dissecting needles were tried for the latter purpose. Even with these fine tools, however, roots were frequently broken off either by the dissecting needles themselves or by clods of earth coming away with portions of the root embedded in them: moistening the soil with water was not sufficient to prevent this.

The method that finally proved quite the most satisfactory was to wash away the soil with a strong jet of water from a garden spray foot-pump. It was found that by directing the jet almost parallel with the roots there was very little danger of breakage, and they could be exposed right to their extremities in this way. If a root was found to travel slightly away from the working face, it was a simple matter to make preliminary excavations with the implements described above using the jet of water for the more delicate work of exposing the root.

The greatest difficulty was experienced when the roots had to be followed into and through beds of Iron sesquioxide (murram ; ou' klip ; pea-ironstone) which were struck at depths of from 3-4 feet in these areas. Many of the deeper roots were broken off on account of this, but in nearly every plant studied, some idea of the maximum root depth was obtained by the workers, who succeeded in tracing at least one or two of these roots down crevices in the rock to their extremities.

Naturally, in this type of root study, only the roots that occurred in the one plane parallel to the working face were studied, the remainder either having been broken off in the digging of the pit or being impossible to follow due to their distance from the working face.

Discussion of Results.

The species selected for this preliminary study were :—*Themeda triandra*, Forsk., *Cymbopogon plurinodis*, Stapf., *Tristachya Rehmannii*, Hack., *Elyonurus argenteus*, Nees., *Digitaria tricholaenoides*, Stapf., *Brachiaria serrata*, Stapf., *Cynodon dactylon*, Pers., which were all found growing in the granite soils of the typical grassveld in this area. Up to the present it has been possible to chart only one root system of each species selected, as the time taken is usually one day for each. Although it will be necessary to replicate this work for conclusive results, the charts now to hand show some very marked characteristics which are worthy of mention.

From the differences in the layout of the root system it was possible to divide the above species into three distinct classes :—

1. Those with superficial root systems.
2. Those with deep root systems.
3. Those with deep roots but also having well developed lateral roots for surface feeding.

1. The two species in this class are *Themeda* and *Cymbopogon plurinodis*. From Fig. 1, it will be seen that the former has a very much branched and shallow root system which extends a considerable distance in a horizontal direction forming a close network a few inches from the surface of the soil. Some of the roots descended vertically to a depth of about one foot and some appeared to go further, but these could not be traced back to the plant. These deeper roots, however, were few. The similarity between the root systems of *Themeda* and *Cymbopogon* was very noticeable, but in the individual case studied both the lateral spread and the maximum depth was greater. From this it is reasonable to suppose that these two species are able to make use of surface soil water and nutrients before

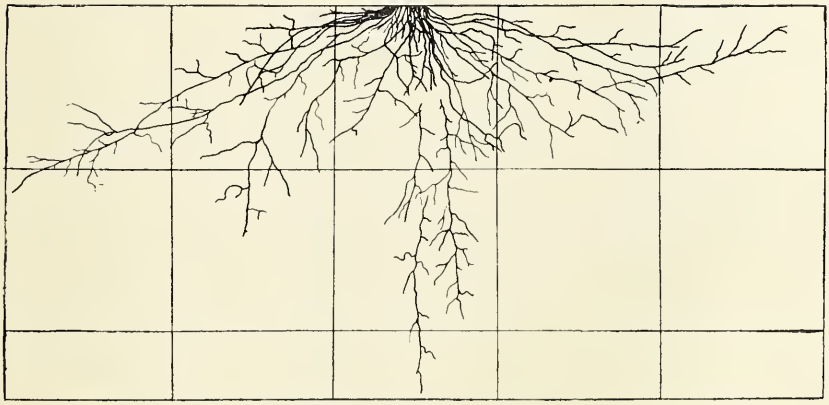

Fig. 1. *Themeda triandra*. Scale, 1 in. = 6 ins.

they reach the deeper rooted pioneer species, and that they belong to a stage approaching the climax in the grassland succession.

2. In this class come *Digitaria tricholaenoides*, *Tristachya Rehmannii*, and *Elyonurus argenteus*, the root systems of which form a very marked contrast with those in class 1. There is much less branching and very poor development of laterals, the roots for the most part travelling vertically downwards to a depth of about 3 feet and branching more profusely towards the extremities. Fig. 2 shows these characters clearly exemplified by *Digitaria tricholaenoides*.

3. *Brachiaria serrata* and *Cynodon dactylon* form good examples of this class of root system. In the case of *Brachiaria*, a few roots penetrated to a depth of 4—5 feet, besides there being a strong development of lateral roots at the surface. *Cynodon* shows this characteristic to an even greater

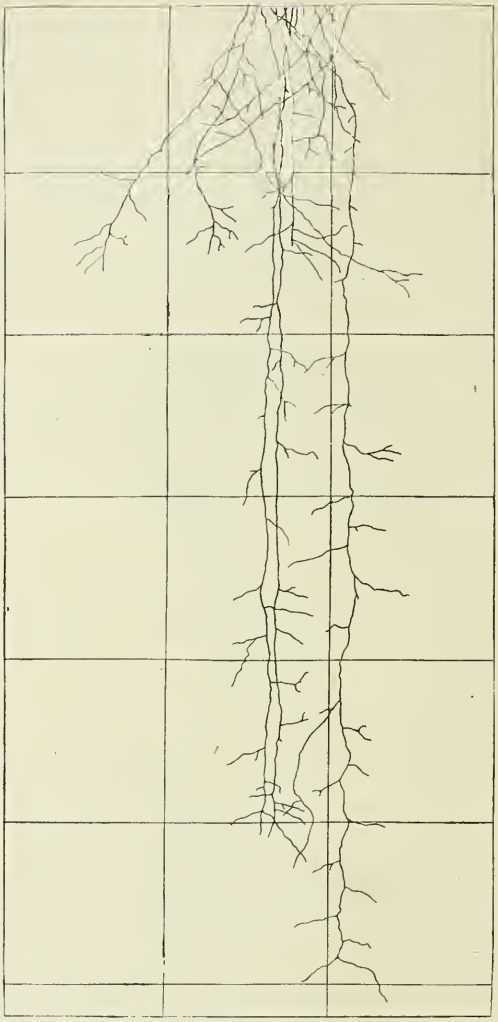

FIG. 2. *Digitaria tricholaenoides.* Scale, 1 in. = 6 ins.

degree, and it can be seen from Fig. 3 how well developed and branched are the roots near the surface and at the extremities of the deepest roots, as compared with the intervening section.

It would appear from this that these two species would be able to compete with any of the above species, and the even distribution of *Brachiaria*

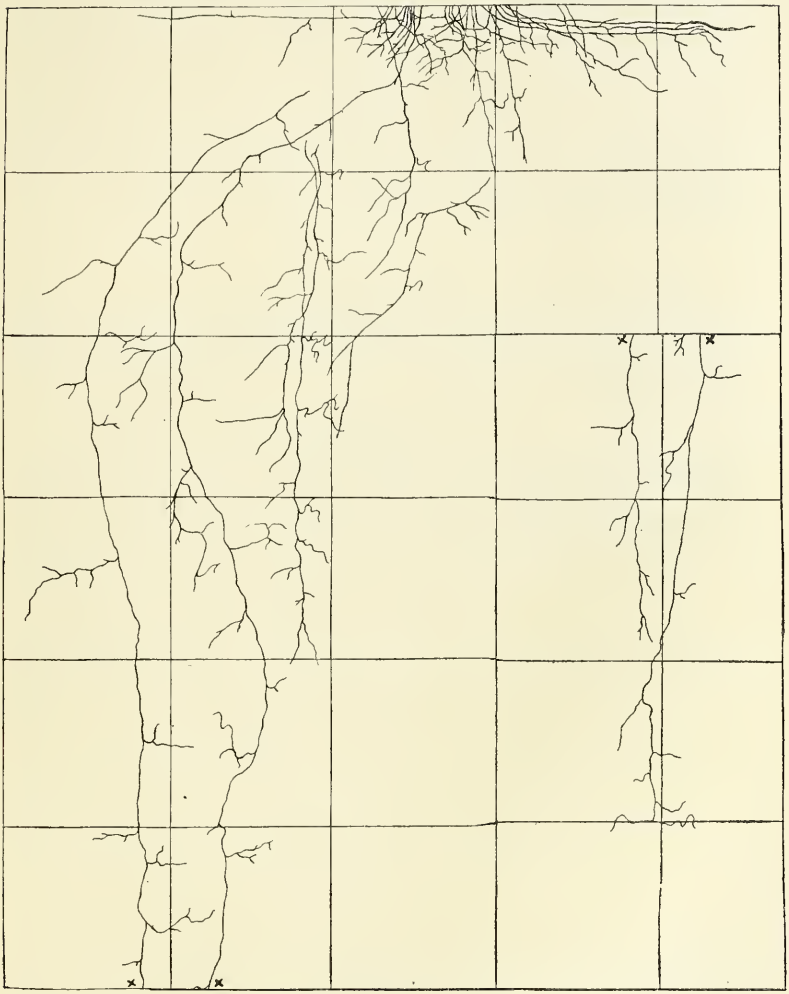

FIG. 3. *Brachiaria serrata.* Scale, 1 in. = 6 ins.

serrata in this veld seems to bear out this statement. *Cynodon dactylon*, however, which appears to be a light demanding species with a prostrate

habit, is only found to any extent as a coloniser of bare areas, in primary and secondary successions.

In discussing the results of this preliminary study, it must be emphasised that it is the intention of the writers to replicate the work on the above species, in order to make sure that the charts are representative of the species in each case. It is also hoped that, with the recommencement of these investigations, other workers will work concurrently upon the detailed structure of the roots, and upon the analysis of soil samples taken at depths where maximum root development takes place. These and many other important fields of study are opened up when a plant is studied from below as well as above ground level.

Acknowledgments.

The writers wish to acknowledge their indebtedness to Dr. John Phillips, Professor of Botany in the University of the Witwatersrand, who suggested that these studies be carried out, for his very helpful advice and criticism.

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THE GENUS PEYROUSEA D.C.

With the Description of a New Species

By

R. H. Compton.

The study of a new species of this curious genus of Compositae which I describe below as *Peyrousea argentea* has led me to investigate the history of the genus itself. In this I have had the advantage of help from Dr. J. Hutchinson of the Kew Herbarium, and his observations are incorporated in what follows.

The earliest description of a plant now placed in Peyrousea was that of Linnaeus fil. (Suppl. 378, 1781), who described as *Cotula umbellata* a plant in the Bäck Herbarium. Application to Upsala for the type of this and of *Osmites calycina* L.f. (see below) resulted in the receipt of only one sheet labelled *Lapeirousia calycina.* This specimen agrees exactly with Linnaeus fil.'s description of *Cotula umbellata.*

The generic name Lapeirousia (with one species, *L. calycina*) was coined by Thunberg (Prod. 163, 1800). No description was given but *Osmites calycina* L.f. was quoted as being the plant in question. The description of *Lapeyrousia calycina* in Thunberg's Fl. Cap. 700, 1823, clearly refers to the same plant, *Osmites calycina* L.f. being again cited as a synonym, erroneously as we shall see later: but in neither work did Thunberg refer to *Cotula umbellata* as a synonym.

To return to Linnaeus fil. Two pages later than the above he described another plant, in the Thunberg collection, as *Osmites calycina* (Suppl. 380, 1781). The type of this species is in the Linnean Herbarium in London, and is not in Thunberg's Herbarium at Upsala. It is a quite distinct plant and belongs to the species later named *Relhania quinquenervis* by Thunberg (Prod. 146, 1800, and Fl. Cap. 641, 1823). The same plant was also described by Lamarck as *Osmites calicina* (Ency. IV. 647, 1797) and was figured on plate 704 in 1823. Clearly then, as mentioned above, Thunberg was in error in citing *Osmites calycina* L.f. as a synonym of his *Lapeyrousia calycina.*

The two plants described by Linnaeus fil. as *Cotula umbellata* and *Osmites calycina* respectively are by description quite distinct from one another. Now Lessing (Syn. 260, 1832) makes these two names synonymous with one another, his description clearly indicating that it was *Cotula umbellata* L.f. with which he was dealing, and not *Osmites calycina :* he thus makes the same mistake as Thunberg had made in 1800 and 1823, and also uses Thunberg's name, *Lapeyrousia calycina,* for the species.

By this time, therefore, it seems that the plant originally described as *Osmites calycina* L.f., which as we have seen is a Relhania, had disappeared from the ken of botanists concerned and it appears probable, either that the original gathering had somehow been substituted by a "*Cotula umbellata*," or that having found its way to England it had been lost sight of and its identity had been mistaken.

De Candolle (Prod. VI. 77, 1837) modified Thunberg's generic name to Peyrousea, presumably to avoid confusion with Lapeyrousia Pourr., a genus of Iridaceae with prior publication (1788), which had also been named in compliment to "the celebrated and unfortunate circumnavigator." De Candolle included two species, which he regarded as doubtfully distinct, namely, *Peyrousea oxylepis*, for which he quotes *Cotula umbellata* L.f. as a synonym, and *P. calycina* for which he quotes *Osmites calycina* L.f. as a synonym. He thus perpetuates the mistake made by Thunberg and Lessing. Later, also, Harvey (Fl. Cap. III. 176, 1865) followed De Candolle in keeping two species, *P. oxylepis* D.C., and *P. calycina* D.C.

Dr. Hutchinson and I have, between us, examined a considerable number of specimens, including the types, and have come to the conclusion that *P. calycina* D.C. and *P. oxylepis* D.C. are conspecific. (The material in the Kew Herbarium, the Bolus Herbarium and the Herbarium of the South African Museum, Cape Town, was examined by one or both of us). Burchell 5185, collected on the Paardeberg, Knysna Division, on the 27th March, 1814, and quoted by De Candolle as the type of *P. oxylepis* D.C. was among the specimens seen. Harvey had suggested that it was "possibly a starved condition of *P. calycina*."

If this view, that De Candolle's two plants are conspecific, be accepted, and if the generic name Peyrousea be maintained, it follows from the above history that the specific name *umbellata* must be adopted, *Cotula umbellata* L.f. being the earliest name applied to the plant. This was recognised by Fourcade (in Trans. Roy. Soc. S. Africa, XXI. 87, 1932). The following year, however, Dandy and Taylor (in Journ. Bot. LXXXI. 156, 1933) questioned this, but even on the basis of their own citations it appears that they are wrong in thinking that *P. calycina* (L.f.) D.C. should be the correct name. In view of the above discussion the name *Peyrousea umbellata* (L.f.) Fourcade must be adopted.

A further question arises with regard to the plant originally described as *Osmites calycina* by Linnaeus fil., and again described and figured under this name in the Lamarck Encyclopedia. Consideration of these descriptions, the figure and Thunberg's actual specimen now in the Linnaean Herbarium makes it clear that this is the species described by Thunberg as *Relhania quinquenervis*. (Prod. 146, 1800, and Fl. Cap. 641, 1823). In a later published volume of the French Encyclopedia (VI. 95, 1804)

Poiret refers to this *Osmites calycina*, and perceiving that it is in reality a Relhania calls it *Relhania calicina*. As the specific name *calycina* has priority it must be adopted in preference to *quinquenervis*, and the correct name of the species is therefore *Relhania calycina* (L.f.) Poir.

The following is the principal synonymy of these two species :—

Peyrousea umbellata (L.f.) Fourcade in Trans. Roy. Soc., S. Africa XXI. 87, 1932.

Cotula umbellata L.f. Suppl. 378, 1781.
Lapeirousia calycina Thbg. Prod. 163, 1800.
Lapeyrousia calycina Thbg. Fl. Cap. 700, 1823.
Peyrousea oxylepis D.C. Prod. VI. 76, 1837.
Peyrousea oxylepis Harv. Fl. Cap. III, 176, 1865.
Peyrousea calycina D.C. Prod. VI. 76, 1837.
Peyrousea calycina Harv. Fl. Cap. III. 176, 1865.
Lapeyrousia Thunbergii Cass. Dict. Sc. Nat. XXV. 251, 1822.

Relhania calycina (L.f.) Poir. Ency. VI. 95, 1804.

Osmites calycina L.f. Suppl. 380, 1781.
Osmites calicina Lam. Ency. IV, 647, 1797, and pl. 704, 1823.
Relhania quinquenervis Thbg. Prod. 146, 1800, and Fl. Cap. 641, 1823.

When climbing Formosa Peak, the highest summit of the Outeniqua Mountains, on 4th May, 1933, I met with a number of scattered plants of what appeared to be a Peyrousea very distinct from *P. umbellata*. They were growing at an altitude of about 5,000 feet above sea level, on open slopes, and were conspicuous on account of their shining silvery foliage and bright golden sessile capitula. Further examination has led me to the conclusion that they should be regarded as a new species, and this I now proceed to describe as *Peyrousea argentea*.

Peyrousea argentea, Compton. (Compositae—Anthemideae).

Frutex erectus, parum ramosus. *Caules et folia* indumento argenteo pilorum appressorum utrinque dense obtecti. *Folia* numerosa, imbricata, erecto-patentia, sessilia, elliptica vel lanceolata, long. 1.5—2.0 cm., lat. 6—8 mm., integra, plana vel leviter incurvata, acuta, mucronulata, mesonevris subter prominentibus in internodos decurrentibus. *Capitula* in apicibus ramorum, solitaria vel 2—4 aggregata, subsessilia vel breviter pedunculata, discoidea, diam. 1.5—1.8 cm. *Bracteae* involucrales numerosae, in seriebus 3 vel 4 imbricatae, anguste lanceolatae, subter et in marginibus dense appresso-sericeo-villosae, supra glabrae, long. ad 6 mm., lat. ad 2 mm., flosculis aequantes vel excedentes, apicibus scariosis, erosulis, purpuratis vel subflavis. *Receptaculum* convexum. *Flosculi* numerosi. *Corolla* flava, rugulosa, tubulata, long. ad 3 mm., segmentis 4, brevibus, subcucullatis, glande subapicale dorsale instructis. *Achaenium* complanatum, carinatum, epapposum, long. 3 mm.

Hab. Cape Province : Uniondale Division ; Formosa Peak, north slope, 5,000 ft. alt., 4th May, 1933, *Compton* 4202 (*type*, in Herb. Bolus) ;

Blaauw Bosch Nek, 3,400 ft. alt., May, 1924, *Fourcade* 2994 : George Division ; Georgetown Mountain, 7th August, 1847, *Prior* in Herb. Kew.

Peyrousea argentea differs from *P. umbellata* in its more condensed growth, its smaller, stiffer and relatively more numerous leaves, the more shining silvery indumentum, the much smaller panicle with much shorter or almost non-existent peduncles and very few capitula. These characters are best shown by plants from higher altitudes (e.g., *Compton* 4202, *Fourcade* 2994) but are noticeable also in those from lower ground, though in the latter case the peduncles tend to be slightly elongated. It is a plant of open mountain slopes, whereas *P. umbellata* is mainly a plant of the forest or forest margin at relatively low altitudes. It is possible that *P. umbellata* and *P. argentea* may eventually by experiment be proved to be conspecific, but I do not expect this ; and certainly forms such as *Compton* 4202, the type of *P. argentea*, from Formosa Peak at 5,000 ft. alt., and *Schlechter* 2356 which I take to be characteristic of *P. umbellata*, from forest margins near George at 800 ft. alt., are strikingly different from one another in appearance and characters.

PLANTAE NOVAE AFRICANAE.

" Ex Africa semper aliquid novi."—*Pliny.*

SERIES II.

By
Paymaster-Captain T. M. Salter, R.N. (Ret.)

With Text Figures drawn by the author and Miss W. F. Barker.

Oxalis cathara, Salter (Oxalidaceae) § Multifoliolulatae.

Planta robusta, glabra (nisi tamen in pedunculis) caule non vel breviter exserto. *Bulbus* ovoideus, ad 2.5 cm. longus : tunicarum apices plurime elongati, fibrosi, filiformes, longissimi, rhizoma obtegentes. *Rhizoma* 25 cm. longum vel longius, superne fere robustum, ad apicem squamis ovatis amplexicaulibus membranaceis cuspidatis, ad 7 mm. longis, indutum. *Folia* 7—11, basalia : petioli 3—10 cm. longi, ad basin manifeste articulati, inferne (infra articulum) in squamis submembranaceis, prominenter nervatis, ad 1.5 cm. longis, in ambitu ovatis vel ovato-lanceolatis, sed apice bilobulatis, dilati, superne teretes, basi in sinu inter lobos articulata : foliola 8—12, basi cum petiolis articulata, linearia vel anguste lineari-cuneata 2—3 cm. longa, 2—3 mm. lata, acute emarginata, tenuia, nervo mediale conspicuo, leviter penninervata, apice callis 2 minutis (in vita) aurantiacis, instructa. *Pedunculi* uniflori, robusti, ad basin manifeste articulati, 7—18 cm. longi, inferne glabri, ad apicem patenter glanduloso-pilosi, in parte superiore bibracteati bracteis lanceolatis 3—5 mm. longis, submembranaceis, apice aurantiaco-callosis. *Sepala* oblongo-lanceolata, obtusa, 7—9 mm. longa, subpellucida, apice callis 2—5 elongatis aurantiacis instructa. *Corolla* 2.2—2.8 cm. longa, alba, tubo infundibuliformc, luteo : petala e basi subcuneata oblique obovata, margine anteriore leviter retusa, 1.2—1.7 cm. lata. *Filamenta* (parte connata inclusa) exteriora 3—4 mm. longa, glabra, interiora 4.5—7 mm. longa, inferne minute glandulosa, superne glabra, late prominenterque gibbosa *Ovarium* oblongum, 2 mm. longum, in dimidio superiore minutissime glandulosum, stylis minute glandulosis. *Capsula* anguste conica, loculis 3—4 ovulatis.

Hab. Cape Province, Namaqualand : 9 miles south of Garies, in damp clayey soil, 13 July, 1932, *Salter* 2526 (*type* in Bolus Herbarium). An affinity of *O. flava*, Jacq., somewhat resembling the pale mauve form of that species and, like it, breaking up very readily at the articulations

in the dry state. It differs in having white petals, straight (not falcate or conduplicate) leaflets of thin almost transparent texture and glandular hairs on the upper part of the peduncle. The bulb penetrates to a great

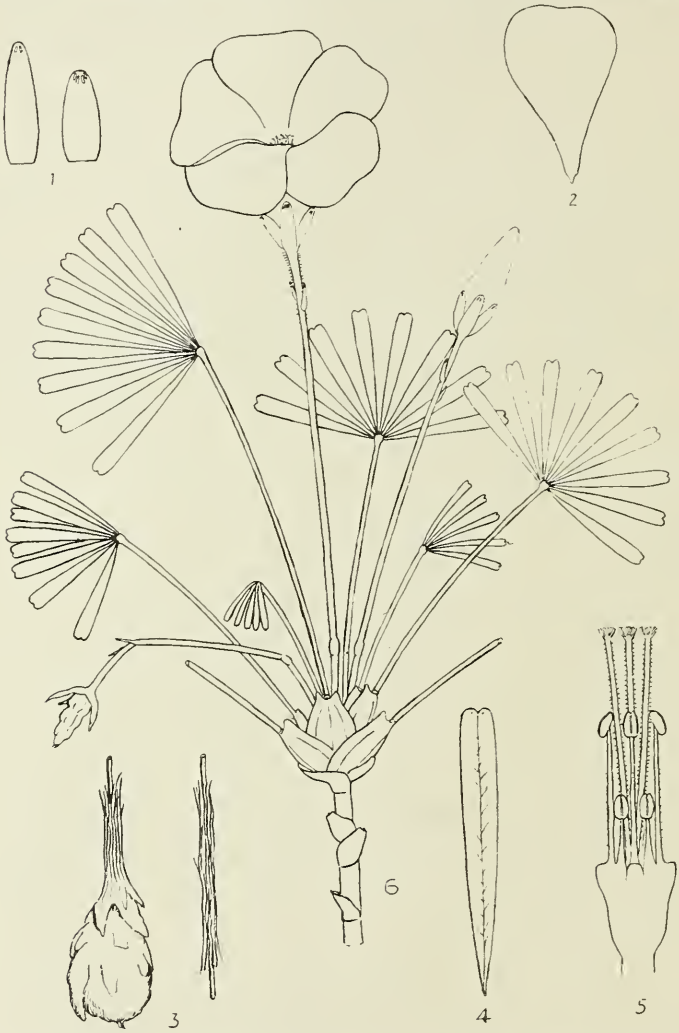

FIG. 1. *Oxalis cathara* Salter. 1. Sepals × 2. 2. Petal, natural size. 3. Bulb and part of rhizome, natural size. 4. Leaflet × 2. 5. Androecium and styles × 8. 6. Plant, natural size. (*Salter* 2526). *Del.* T. M. Salter.

depth and the tunics are elongated at the apex into long filiform fibres which form a sheath to the exceptionally long rhizome, a character which seems to be peculiar to this species. (v.v.s., v.v.c.)

Oxalis xantha, Salter (Oxalidaceae) § Tripartitae (Lineares).

Planta gracilis, 8—19 cm. alta, caule satis exserto. *Bulbus* ovoideus vel globoso-ovoideus, paulo attenuatus, fere 1.5 cm. longus: tunicae

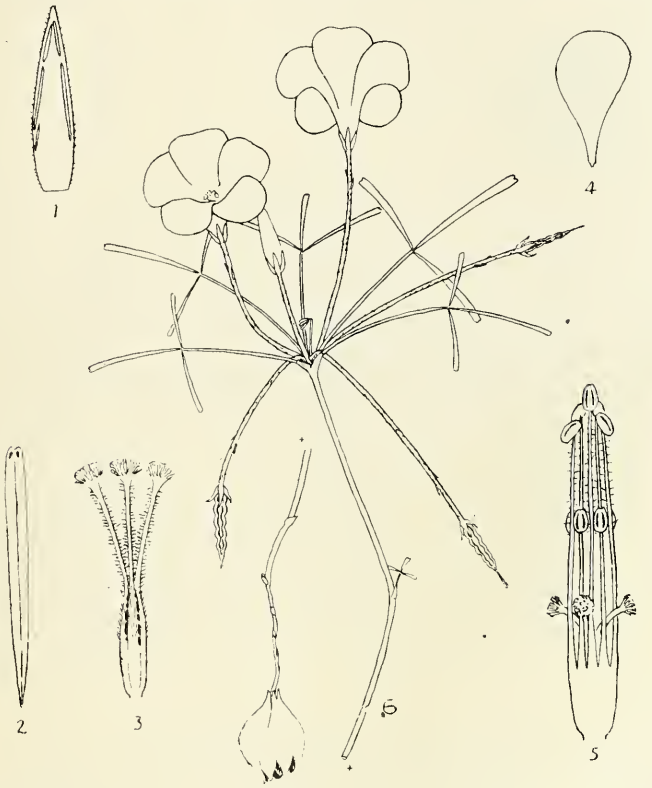

Fig. 2. *Oxalis xantha* Salter. 1. Sepal × 8. 2. Leaflet × 2. 3. Gynaecium × 8. 4. Petal, natural size. 5. Androecium showing styles × 8. 6. Plant, natural size. (*Salter*, 2470). *Del.* T. M. Salter.

tenues, apice acutae, inconspicue depresso-punctatae, pallide brunneae, longitudinaliter nervatae. *Rhizoma* breve, squamis paucis instructum. *Caulis* rigidus, simplex vel sparse ramosus, 3—15 cm. longus, glaber vel

brevissime sparseque pubescens, viridis, squamis 1—3 amplexicaulibus brunneis, inferioribus saepe ciliatis, vel foliis 1—2, abortivis, indutus. *Folia* petiolata, ad 14, ad apices caulis ramorumque aggregata : petioli 1—2 cm. longi, glabri vel sparsissime pubescentes, basi (infra articulum) dilati, ciliati : foliola 3, sessilia, linearia, saepe conduplicativa vel involuta, leviter emarginata, ad 2 cm. longa, 1—1.5 mm. lata, supra glabra, infra sparse pubescentia, inconspicue nigro-punctata, callis 2 elongatis apice instructa. *Pedunculi* uniflori, satis numerosi, 1.5—3 cm. longi, pubescentes, post anthesin deflexi, in parte superiore bibracteati bracteis alternantibus adpressis, callosis, ciliatis, 1—1.5 mm. longis. *Sepala* lanceolata 3.5—4 mm. longa, sparse pubescentia, ciliata, ad apicem marginemque callis linearibus aurantiacis ornata. *Corolla* 2—2.4 cm. longa, omnino (in vita) laete flava, (in sicco) aureo-flava, tubo infundibuliforme concolore : petala e basi leviter attenuata oblique obovata, 0.9—1.1 cm. lata, callis inconspicuis elongatis aurantiacis ad marginem anteriorem notata. *Filamenta* (parte connata inclusa), exteriora 2.5—4 mm., glabra, interiora 4—7.5 mm. longa, inaequalia, superne sparse pluricellulari-pilosa, edentata. *Ovarium* oblongum, 1.7—2.2 mm. longum, in dimidio superiore cano-pubescens, superne inter angulos callis brunneis, longitudinaliter dispositis, ornatum, stylis dense pluricellulari-pilosis, stigmatibus fimbriatis aureis. *Capsula* moniliformis, ad 1.5 cm. longa, conspicue callosa, loculis 5—6 ovulatis.

Hab. : Cape Province, Clanwilliam Div. : between Pakhuis and Doornbosch, about 2 miles south of Langekraal, 10 July, 1932, *Salter* 2470 (*type* in Bolus Herb.) and 2472.

Probably nearest to *O. gracilis*, Jacq., sometimes having the same branching habit. It has not, however, the characteristic polished brown stem of that species and differs also in having a yellow corolla, styles with longish pluricellular hairs, and in many other minor particulars. Though apparently local it extended for about a mile along the road-side. It grows in a very arid region and it is evidently dependent on favourable rains, for it made no appearance during the two subsequent seasons. (v.v.s., v.v.c.)

Oxalis attaquana, Salter (Oxalidaceae) § Obcordatae.

Planta erecta, caule satis exserto, ad 13 cm. alta, in multis partibus pilosis pilis longis hyalinis pluricellularibus nitentibus. *Bulbi* ovoidei, paulo attenuati, congesti, distorti, 1.5—2 cm. longi, hornotini superne tunicis inferioribus anni praeteriti bulborum saepe imbricato-complexi. *Rhizoma* gracile, squamis parvis amplexicaulibus instructum. *Caulis* erectus, simplex vel bifurcatus, cum ramis ad 8 cm. longus, glaber, laete brunneus, squamatus : squamae caulis satis numerosae, amplexicaules,

cuspidatae, brunneae, inferiores lato-ovatae, ad 2 mm. longae superiores ovato-lanceolatae, apiculatae, laxe imbricatae, glabrae, 5—7 mm. longae (in forma bifurcata, squamae ramorum ovato-lanceolatae). *Folia* ad 24, petiolata, in parte superiore caulis ramorumque aggregata, petiolis ad 3 cm. longis, ad basin articulatis, inferne (infra articulum) squamiformibus, patenter pluricellulari-pilosis: foliola 3, medium breve petiolulatum,

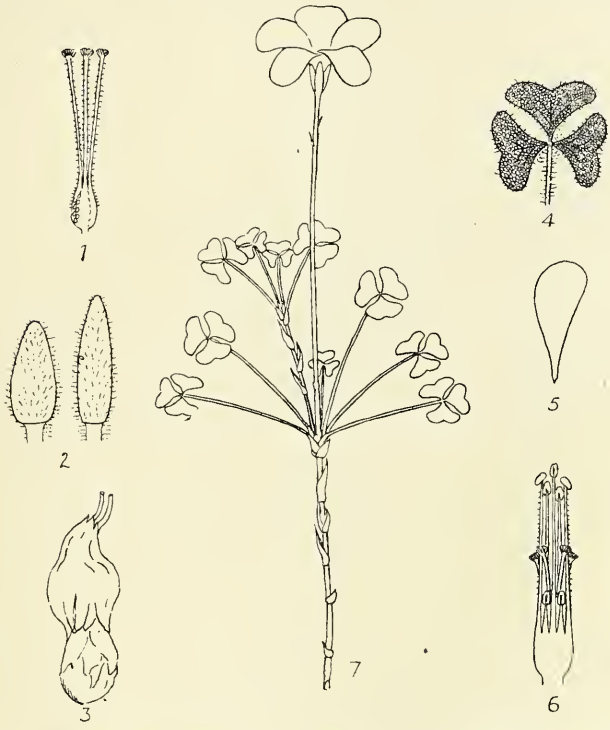

Fig. 3. *Oxalis attaquana* Salter. 1. Gynaecium × 4. 2. Sepals × 3. 3. Bulb, natural size. 4. Underside of leaf × 2. 5. Petal, natural size. 6. Androecium, showing styles × 4. 7. Plant, natural size. (*Salter* 2341). *Del.* T. M. Salter,

lateralia sessilia, e basi attenuata obreniformia vel latissime cuneato-obcordata, ad 5 mm. longa et 9 mm. lata, lobis apice subrotundatis, utrinque (in sicco) valde depresso-punctata, supra glabra, infra in nervo medio et ad basin sparse pluricellulari-pilosa, pilis brevibus capitatis pilisque paucis pluricellularibus admixtis ciliata. *Pedunculi* 1 vel 2, uniflori, e axillis foliorum exorientes, folia 2-plo superantes, ad basin

articulati, sicut petioli pilosi, supra medium bibracteati bracteis linearibus, ad 2 mm. longis, brunneis. *Sepala* lato-lanceolata vel ovato-lanceolata, subobtusa, fere 5 mm. longa, pluricellulari-pilosa ciliataque, ecallosa, saepe purpurascentia. *Corolla* 1.6—2.1 cm. longa, rosea, tubo anguste infundibuliforme, pluricellulari-piloso, luteo: petala oblique cuncata, ad basin paulo attenuata, superne rotundata, 5—8 mm. lata, ad marginem exteriorem lutescentia et sparse pluricellulari-pilosa. *Filamenta*

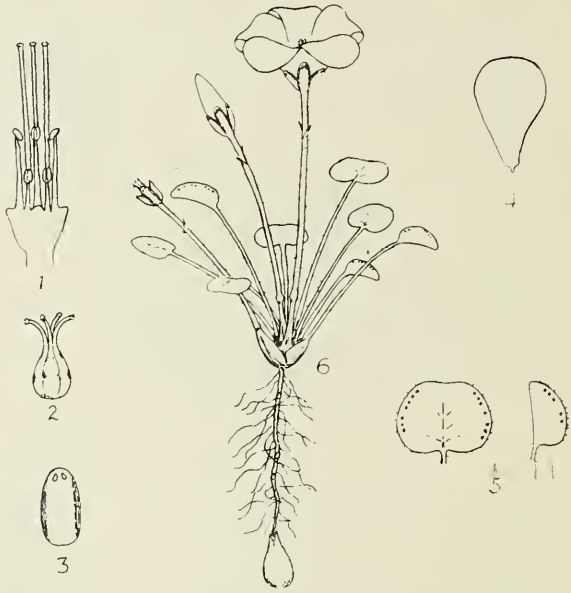

Fig 4. *Oxalis simplex* Salter. 1. Androecium, showing styles × 8. 2. Gynaecium × 8. 3. Sepals × 6. 4. Petal × 2. 5. Leaf, underside × 3. 6. Plant × 2. (*Salter* 2464). *Del.* T. M. Salter.

glanduloso-pilosa, (parte connata inclusa) exteriora 3—5.5 mm., interiora 5—8 mm. longa, inaequalia, edentata. *Ovarium* ovato-oblongum, 1.5 mm. longum, in dimidio superiore glanduloso-pilosum, loculis 8-ovulatis, stylis glanduloso-pilosis.

Hab. Cape Province, Oudtshoorn Div.: Attaquas Range, near Moeras River, 10 miles north of Robinson Pass, 15 June, 1932, *Salter* 2341 (*type* in Bolus Herbarium).

Probably an affinity of *O. aganophila*, Sond., a somewhat imperfectly known species only collected once by Zeyher. It differs in the shape and

stout texture of the leaflets on which the collapsed cells are very conspicuous in the dried state. The plant is coated with longish viscid hyaline pluricellular hairs, which give it, in the sunlight, the appearance of being bedewed. (v.v.s., v.v.c.)

Oxalis simplex, Salter (Oxalidaceae) § Simplicifoliae.

Planta parva, caule non exserto, 2—3 cm. alta. *Bulbus* ovoideus, paulo attenuatus, ad 5 mm. longus, tunicis papyraceis brunneis. *Rhizoma* gracile, 1—4 cm. longum. *Folia* 6—12, basalia, unifoliolulata, petiolis 0.3—2.0 cm. longis, sparse minuteque glanduloso-pilosis : lamina suborbicularis, interdum basi apiceque leviter retusa, saepe conduplicativa, 2—4 mm. longa, saepe paulo latior quam longa, sparse minutissimeque glanduloso-ciliata, infra ad marginem callis parvis atris notata. *Pedunculi* uniflori, 2—4, 1—2 cm. longi, ad basin articulati, minute glanduloso-pilosi, in parte superiore bibracteati bracteis parvis alternantibus, vix 1 mm. longis, superne callosis. *Sepala* oblongo-elliptica, obtusa, 2—2.5 mm. longa, glabra, callis 2 rubris ad apicem instructa. *Corolla* 0.9—1.1 cm. longa, alba vel rare pallide rosea, late tubiformi-campanulata : petala cuneato-obovata, 5—6 mm. lata, obscure nervata, basin versus lutea, ad marginem exteriorem pallide rubescentia. *Filamenta* glabra, (parte connata inclusa) exteriora 1.5—2.5 mm., interiora 2.5—4 mm. longa, ad basin valde gibbosa. *Ovarium* ovoideum, glabrum, loculis 1—2-ovulatis, stylis glabris.

Hab. Cape Province, Clanwilliam Div. : in wet sandy ground near Brandewyns River causeway, between Pakhuis and Doornbosch, flowers July—August, *Salter* 2464 (*type* in Bolus Herbarium).

This dwarf plant is one of the smallest of the South African *Oxalis* and belongs to the section *Simplicifoliae*, in which there are only three other known species. It is an affinity of *O. Dregei*, Sond., differing in the shape and thicker texture of its leaves, its smaller size and less lax habit. It was growing in abundance in temporarily waterlogged sandy ground in a site which is baked dry during the greater part of the year. It is probably not a true marsh plant in the same sense as *O. Dregei*. (v.v.s., v.v.c).

Erica trichostigma, Salter, (Ericaceae-Ericoideae) § Orophanes.

Frutex densus, fere 30 cm. altus. *Caules* multi, basales dense congesti, glabri vel sparse puberuli. *Rami* inferiores ob congestionem saepe tortuosi, praecipue juniores puberuli. *Folia* adscendentia vel adpressa, 4-nata, oblongo-lanceolata, subobtusa, (petiolo incluso) 2—3 mm., rarius 5 mm.

longa, supra leviter carinata, infra sulcata, juniora ciliata, seniora solum ad basin saepe ciliata, petiolis minute ciliatis, 0.5 mm. longis. *Flores* copiosi, 2—8 nati, ramulos breves terminantes. *Pedunculi* 2—2.5 mm. longi, puberuli, rubescentes, bracteis 3, ciliatis, fere 0.5 mm. longis, infra medium pedunculi positis. *Sepala* anguste ovata, vel e basi late ovata, superne leviter attenuata, 0.8—0.9 mm. longa, ciliata, rubescentia, in parte

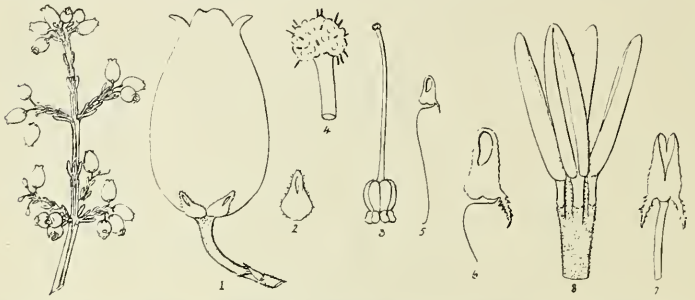

FIG. 5. *Erica trichostigma* Salter. (Natural size.) 1, Flower × 9; 2, Sepal × 9; 3, Gynaecium × 9; 4, Stigma × 36; 5, Stamen, side view × 9; 6, Anther, side view × 18; 7, Anther, back view × 18; 8, Whorl of leaves × 9. (*Salter* 4522.) *Del.* W. F. Barker.

superiore carinata, leviter sulcata. *Corolla* ovato-urceolata, 3.5 mm. longa, glabra, rubro-rosea, segmentis obtusis levissime emarginatis, 0.5 mm. longis. *Stamina* inclusa, filamentis in parte superiore leviter sigmoideis, antheris dorsifixis, cuneato-oblongis, 0.6 mm. longis, poro dimidio lobi, aristis lineari-lanceolatis, ciliatis, 0.3—0.4 mm. longis. *Ovarium* subglobosum, in dimidio superiore minute puberulum, stylo incluso vel manifesto, stigmate capitato *hispidulo*.

Hab. Cape Province, Malmesbury Div.: 4 miles N.E. of Langebaan, in the sand veld, 1 June, 1934, *Salter* 4522 (*type* in Bolus Herbarium).

This species produces numerous stems arising from a common underground root, the branches intertwining to form compact, somewhat dome-shaped tufts. It flowers profusely on the upper branches. The peculiar hispidulous stigma has suggested the specific name.

Its nearest affinity is *E. gracilis*, Wendl., but it differs in having shorter pedicels, smaller bracts, a more inflated and larger corolla, larger and differently shaped anthers, a puberulous ovary and an hispidulous stigma.

Erica × fontensis, Salter (*E. capensis*, Salter × *fontana*, L. Bolus). Ericaceae-Ericoideae.

Frutex robustus ad 1 m. altus, caule ad basin fere 1 cm. lato. *Rami* vix numerosi, adscendentes, juniores pubescentes. *Folia* 4-nata, linearia,

(petiolo incluso) 5—6 mm. longa, infra leviter sulcata, puberula, petiolis fere 1 mm. longis, minute ciliatis. *Flores* 4-nati, ramulos terminantes. *Pedunculi* 2—3 mm. longi, puberuli: bracteae lineares, puberulae, infima ad basin, caeterae paulo infra medium positae. *Sepala* 3 mm. longa, e basi late ovata longe attenuata, minute puberula, ciliata, in parte superiore ($\frac{2}{3}$) carinata, leviter sulcata. *Corolla* tubiformis, ad apicem gradatim amplians, 6.5—7 mm. longa, minute puberula, pallide rosea, ad apicem, praecipue in lobis, albescens, lobis subacutis, 1—2 mm. longis. *Stamina* inclusa, filamentis superne leviter subsigmoideis, antheris dorsifixis oblongis leviter prognathis, 0.8 mm. longis, poro dimidio lobi, aristis filiformibus pallidis, 0.5 mm. longis. *Ovarium* globoso-oblongum, glabrum, stylo incluso, stigmate capitellato.

Hab. Cape Peninsula: marsh between Smitswinkel and Cirkels Vlei, flowers Nov.—Feb., *Salter* 1858 (*type* in Bolus Herbarium). The specimens distributed under this number are all from the same bush.

This rare plant, presumed to be a hybrid, was first noticed in 1931 in a marsh feeding the Krom River (Hout River on the old maps), where the species assumed to be its parents were growing in association. No more than one well grown plant and two smaller ones, apparently identical, could be found after exhaustive search in three successive seasons. Most unfortunately the marsh in question was gutted by a veld fire in 1934 and these plants were exterminated. One further plant (*Salter* 4285) with a slightly longer corolla and in all characters and general appearance a little nearer *E. fontana*, was found in 1934 on the marshy banks of the Krom River, about 2 miles away and here again the supposed parent species were abundant.

That these plants are of hybrid origin there can be little doubt. They occur very sporadically and only in association with the supposed parents and their characters are intermediate between them. They do not set seed readily and the pollen contains a large number of malformed grains (*Salter* 4285 also shows defective pollen). A few seeds, open-pollinated, were obtained from *Salter* 1858 and from these Mr. A. J. M. Middlemost, of the National Botanic Gardens at Kirstenbosch, raised nine seedlings. Of these five have so far flowered. One of them (Fig. A) is near *E. capensis*, but with a longer corolla: the other four (Figs. B, C, D and E) are again intermediate, but incline towards *E. fontana* more than does the " typical " hybrid *E.* × *fontensis* itself.

It will be noticed that the seedlings B and C have muticous anthers as in *E. fontana*, whereas A, D and E have aristate anthers as in *E. capensis*. The corolla colours of *E.* × *fontensis* and of A, B, C, D and E all differ among themselves and from those of the supposed parents. Other characters such as length and breadth of corolla, shape of the ovary,

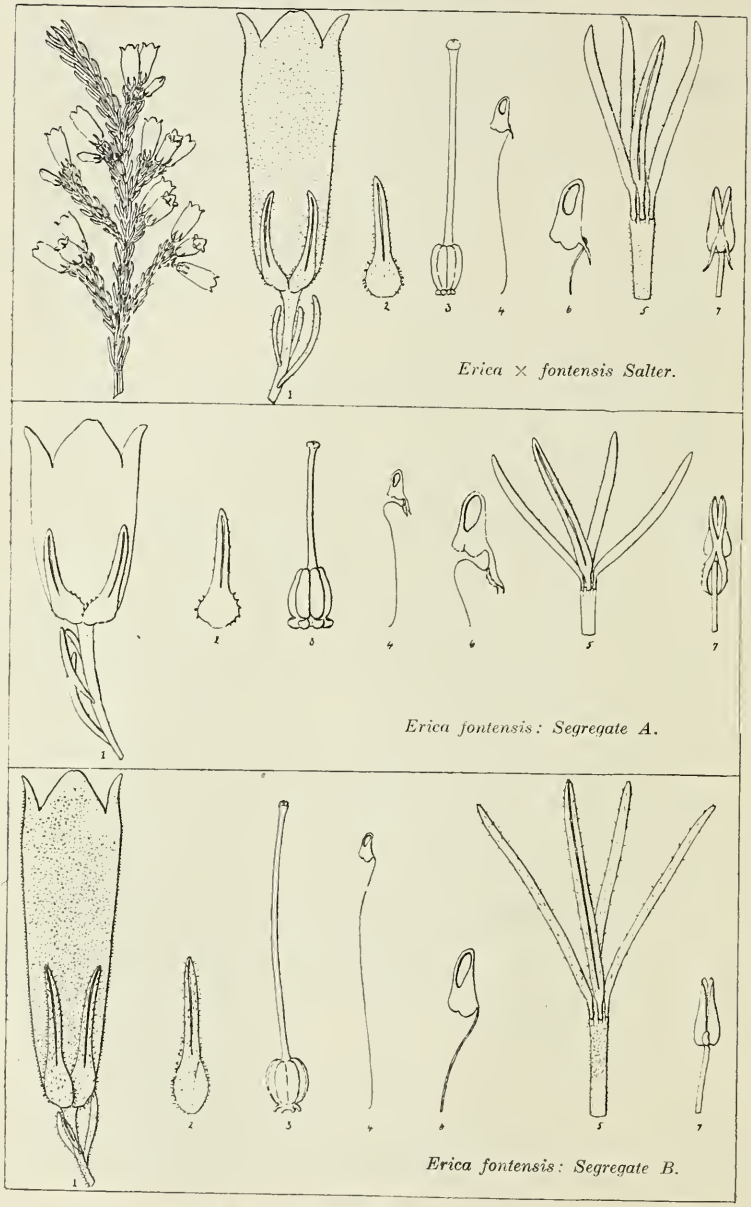

Fig. 6. Erica fontensis and Segregates.

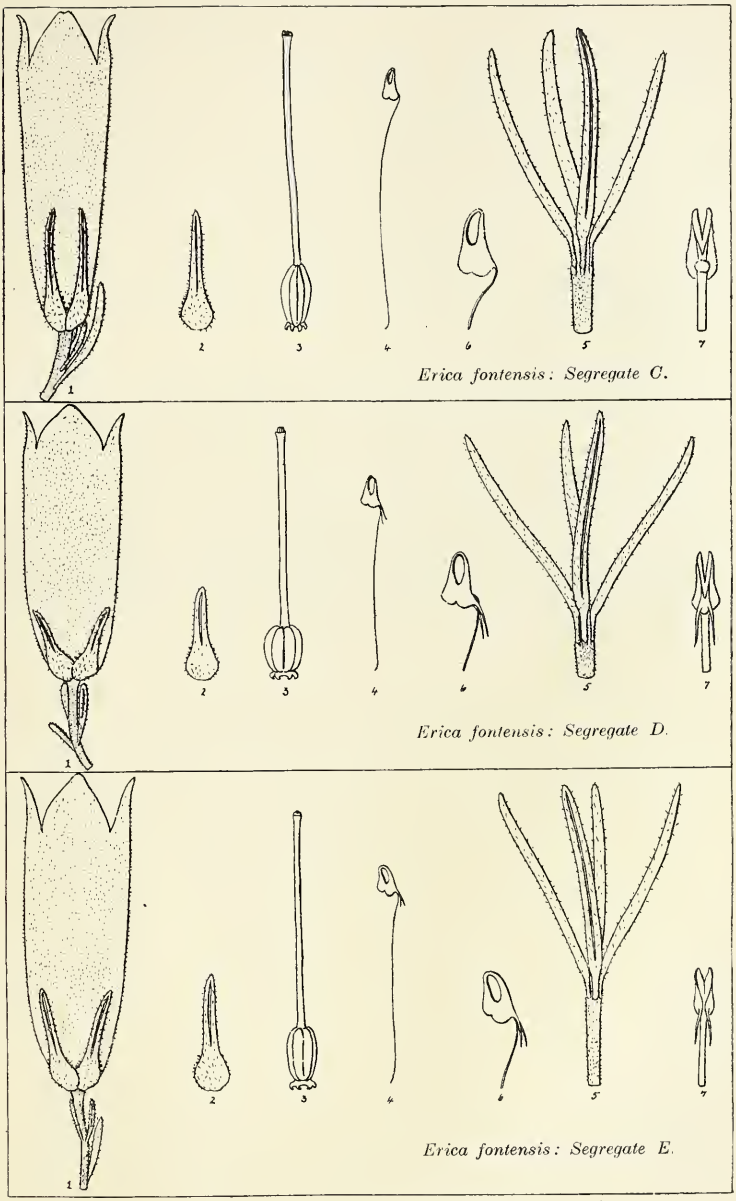

FIG. 7. Erica fontensis Segregates.

sepals and anthers, all vary considerably in the different progeny, as will be seen from the drawings. Clearly segregation, such as usually follows on hybridisation, is taking place.

It is interesting to remark that the two parent species have only been described fairly recently. *E. fontana* is a robust, upright and rather hairy shrub, sometimes reaching 6 feet in height when undisturbed by fires. It has a tubular corolla 9—10 mm. long and it is widely distributed in the southern Peninsula marshes. *E. capensis* is a much smaller, almost glabrous plant with a cup-shaped corolla and is extremely local. It is noteworthy that the two marshes where the hybrid has been found are the only localities known to the writer where both parent plants grow in association.

These hybrids should not be confused with *E. velitaris*, Salisb., as they easily may be from the description of that plant. The late Dr. N. E. Brown, at Kew, however, wrote and told me that Roxburgh's specimen of that species was quite distinct.

I am indebted to Professor R. H. Compton for his advice and co-operation in the preparation of the foregoing notes.

Figs. 6 and 7. *Erica fontensis* Salter, and its segregates. (Natural size.) 1, Flower × 6; 2, Sepal × 6; 3, Gynaecium × 6; 4, Stamen, side view × 6; 5, Whorl of leaves × 6; 6, Anther, side view × 12; 7, Anther, back view × 12. (Salter, 1858. Type, and Segregates A, B, C, D and E.) *Del.* W. F. Barker.

REVIEW.

HENKEL, J. S. The Woody Plants of Natal and Zululand. Durban and Pietermaritzburg. Natal University Development Fund Committee, 1935, pp. xii and 252. 10s. 6d.

The study of the flora of South Africa by others than botanical specialists is at present a matter of difficulty largely owing to the lack of books or other descriptions that are available.

The desire to know something of conspicuous or abundant plants is one generally felt by intelligent persons, tourists or others, whether they possess botanical knowledge or not. In the eastern parts of the country especially, trees and shrubs are the most prominent part of the vegetation, but the identification of them is very often attended with difficulty. Trees are often encountered which are without flowers or have the flowers inaccessible. Even if in good condition, a lack of botanical knowledge may prevent or discourage further study.

It is to meet just such needs that the present small volume has been produced. It represents the results of many years of observation by one trained in practical field work, which are now rendered available even to those with the minimum of botanical knowledge.

As the subsidiary title explains, this is a book for use in the field and the whole is arranged as a series of keys based on the characters of the leaf and general growth habit of the plants. These are so arranged that they can be used by any intelligent person without any previous knowledge of plants.

To the botanist brought up on the strict canons of scientific classification, the arrangement may seem at first unusual, but as the features used are those encountered in the field, the basis becomes apparent. In the construction of the keys the use of a number of technical terms is necessary. These are all defined at the beginning, and, further, an index to the definitions is given at the end. The definitions occupy fifteen pages, which may seem a formidable array but many are really self-explanatory and several appear in more than one connection.

The keys are straightforward and where a division does not immediately follow the one from which it is derived, a reference to the previous number is added, so that the retracing of steps in case of error is easy. A number of variable species appear more than once in which case cross references are given. Each species is described so that the identification does not rely entirely on the characters used in the keys. The descriptions are on the whole adequate, but not always complete. In some the flowers are not mentioned at all. In a few of the descriptions terms seem used in an unnecessary or even misleading way: for example, "Petiole sessile," which appears more than once.

The use of vegetative characters produces some strange arrangements quite at variance with the accepted forms of classification: for example, *Osyris* and *Olea*, or *Sutera* and *Passerina*, are closely placed, while the species of *Protea* are divided sometimes by several pages.

This book, however, does not attempt to give any classification, but only to provide a means of identification. It is one for use in the field or with actual specimens. The key arrangement and the rather short descriptions prevent it having much value for reference otherwise. The proof of its value must be tested by its convenience, reliability, and completeness when used in the field. A few trial identifications which are all the test so far applied, have given correct results with no difficulty.

The book is on the whole well printed and got up. The use of slightly different type for the keys and for the descriptions might have given an increase in clarity. A small improvement would have been an additional space between the name of the authority for the species and the commencement of the description.

There do not appear to be many misprints. On a first reading a few caught the eye: urseolate, *faginae* and *tiliaceous*.

The size is convenient for carrying about and using in the field, though the volume is rather heavy for its bulk.

From the standpoint of the sale and general usefulness of the book it is unfortunate that the price is as high as it is. The non-botanical but interested person may often feel doubtful whether his interest in trees amounts to the required figure whereas a slightly smaller one would be paid without thought.

R. S. Adamson.

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A REVISION OF ELYTROPAPPUS Cass.

By Margaret R. Levyns.
(With drawings by the Author.)

Introduction.

Seventy years have elapsed since the publication of Volume III of the Flora Capensis, and it is therefore no matter for surprise that much of the work in that volume is out of date. The prospects of a complete revision of the earlier volumes of the Flora Capensis are remote, and it is therefore desirable that the revision of individual genera should be undertaken. The need is specially urgent in those genera containing plants of economic importance, such as Elytropappus.

In a recent paper[1] the writer has shown that several changes in nomenclature are necessary in this genus and in the present paper these changes are adopted. In one case (*E. longifolius* of this paper) careful examination of the floral parts made it clear that this plant differs in too many characters from *E. glandulosus* Less. for it to remain satisfactorily as a variety of that species. Consequently it has been given specific rank.

Sub-Divisions of the Genus.

Within the genus the species group themselves into three natural sections, as follows :—

I. *E. cyathiformis* DC
E. hispidus Levyns
II. *E. longifolius* Levyns
E. gnaphaloides Levyns
E. scaber Levyns
E. glandulosus Less.
III. *E. rhinocerotis* Less.
E. adpressus Harv.

[1] Notes on Nomenclature in some Members of the Compositae. Margaret R. Levyns. Trans. Roy. Soc. S.Af. XXIII (1935). p. 91

Very little is known about the plants belonging to the first section. *E. hispidus* on which Cassini founded the genus Elytropappus, has not been collected since its discovery by Thunberg, and *E. cyathiformis* is only a little better known. The writer was fortunate in finding the latter species growing in the mountains in Elands Kloof Pass, where it occurs between the altitudes of 3,000 and 4,000 feet. The flowering season was over but a few heads retained their dried flowers and fruits, thus making it possible to augment the existing descriptions of the species. Its restricted altitudinal range and its preference for coarser grained soils were striking. In this section the capitula are grouped in dense terminal heads, the head resolving itself into its constituent capitula only on a close examination. In the other sections the individual capitula are easily observed. A parallel may be drawn here with the genus Stoebe where the section to which *S. aethiopica* belongs

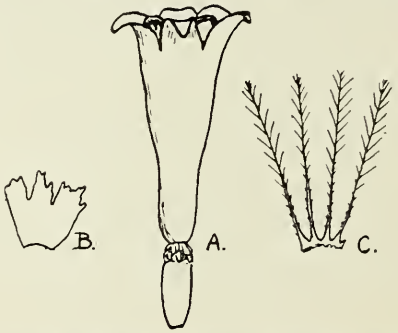

Fig. 1. *Elytropappus longifolius* (DC) Levyns. Drawn from Drège 49698 in the herbarium of the South African Museum. A. Floret with pappus removed × 14. B. A single scale from the ovary × 70. C. Part of the pappus × 14.

shows the same massing of capitula in terminal heads with the boundaries of the capitula obscure. The majority of species in Stoebe agree with most in Elytropappus in having distinct capitula, even where they are massed in heads.

Section II is characterised by its glandular hairs, and by its leaves which are never tightly adpressed to the stem though they may be erect. *E. longifolius* is a somewhat aberrant species both in the shape of its corolla (fig. 1) which is wider in the upper part of the tube than is the case in the other species, and in the entire absence of the rim outside the feathered pappus. This rim which has been regarded as a generic feature is completely lacking and the top of the ovary is covered with a series of downwardly directed, overlapping scales of delicate texture.

The pappus does not persist attached to the achene but falls off as the flower withers. In spite of these unusual features it seems best to place this species in this section. There is some evidence to suggest that hybridisation between it and *E. gnaphaloides* and *E. glandulosus* occurs.

Members of Section III have not the conspicuous external glands of Section II but on drying produce a sticky exudation which causes the plants to stick to drying paper. This feature is never present in Section II. The adult leaves are tightly adpressed to the stem for their whole length.

HYBRIDISATION.

This appears to be a factor of considerable importance in the genus, which is to be expected in view of the tendency of many of the species to grow socially with one another to the partial exclusion of other plants. Members of Sections II and III all flower at approximately the same time (February to May), affording favourable opportunities for crossing. For some time the writer has been convinced that hybridisation is common in the genus, and field studies have only served to strengthen the conviction. Reference to one locality will illustrate the support that field work gives to the hypothesis of hybridisation.

At the Ceres end of Elands Kloof Pass in the Cold Bokkeveld, six of the eight species are present, and distributed as follows :—

E. adpressus abundant on sandy plains at the entrance to the kloof ; becoming less common on the slopes and at high altitudes.

E. rhinocerotis not common and only seen at altitudes of about 4,000 feet, in places where *E. adpressus* is rare or absent.

E. gnaphaloides not very common.

E. scaber frequent, ranging from the flats to about 4,000 feet.

E. glandulosus rare on the sandy flats but becoming very common on the slopes and reaching an altitude of about 5,000 feet.

E. cyathiformis frequent but local on the slopes from 3,000 to 4,000 feet.

E. cyathiformis flowers earlier than the other species and no suspected hybrids were seen.

E. rhinocerotis and *E. adpressus*, though known to hybridise freely in other areas (notably the Koo between Montagu and Matroosberg), showed no evidence of it here. This is probably due to the fact that their areas of distribution in this neighbourhood are not the same.

All the remaining species appeared to be hybridising freely. Attempts were made to determine the possible parents in some of these suspected hybrids, these being judged by their vegetative and floral characters and also by the occurrence of the putative parents in the same locality. The following were the results :—

E. scaber × *E. glandulosus* (Levyns 4924, 4928, 4929, 4931).

E. glandulosus × *E. gnaphaloides* (Levyns 4889).

E. scaber × *E. gnaphaloides* (Levyns 4923).

In a neighbourhood where so many closely related species are growing together it would be surprising if hybrids did not arise.

The presumed hybrid *E. scaber* × *E. gnaphaloides* has been found on the mountains near Muizenberg where *E. scaber* is very common and *E. gnaphaloides* occasional.

A specimen at Kew, collected by Kuntze at Caledon, is possibly a hybrid between *E. glandulosus* and *E. longifolius*. Another, Burchell 7965, combines the characters of *E. longifolius* and *E. gnaphaloides* and may be a hybrid. This is given support by the fact that both the species in question are known to occur at Genadendal where Burchell collected his specimen.

In both Sections II and III hybridisation appears to occur. So far inter-sectional hybridisation has not been observed even when the species are growing massed together.

Variation.

Field workers will find themselves in complete agreement with Vavilov[1] when he says that the monotypic nature of many wild Linnaean species will only be upheld as long as they are studied by means of a few herbarium specimens. Once the botanist goes into the field he cannot but be struck by the polymorphic nature of most species.

In the absence of breeding tests or cytological examination the worker will be faced with the difficult and sometimes insoluble problem of distinguishing between true variations and aberrant forms due to hybridisation. In a genus such as this the task is unusually difficult owing to the gregarious habits of the species. Only in localities in which one species alone in growing can any trustworthy observations on polymorphism be made. The outstandingly polymorphic species in Elytropappus are *E. rhinocerotis* and *E. gnaphaloides*, the two most widely spread species in the genus. Variations have also been observed in *E. scaber* and *E. glandulosus*.

[1] The Law of Homologous Series in Variation. N. Vavilov. Journ. Gen. XII (1922). p. 45.

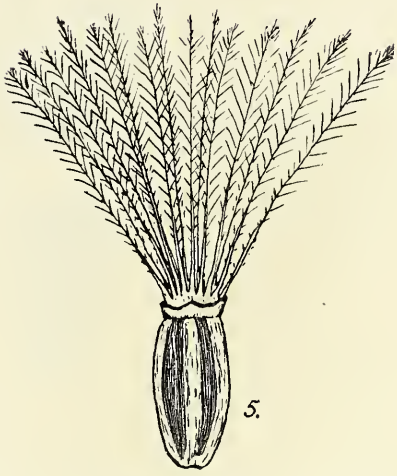

Fig. 2. *Elytropappus rhinocerotis* Less. Portions of two shoots. A. Form with elongated axes. B. Form with condensed axes and smaller leaves. The stems are densely covered with white wool, hence A appears more grey than B. Drawn from two plants growing side by side × 8.

Fig. 3. *Elytropappus glandulosus* Less. Single floret × 14.

Fig. 4. *Elytropappus gnaphaloides* Levyns. Floret × 14.

Fig. 5. *Elytropappus rhinocerotis* Less. Form with an unusually well-developed rim outside the pappus × 14.

With regard to purely vegetative features the most common variant is that in which the internodes are much contracted and the leaves, which are shorter than usual, much crowded in consequence. The general telescoping of the parts extends to the inflorescence axes so that the groups of capitula are sessile or nearly so. The result is a plant very different in appearance from the plant with more elongated axes, (fig. 2). When this type of variation was first noted in *E. rhinocerotis* it was thought that possibly two distinct species were involved.[1] An

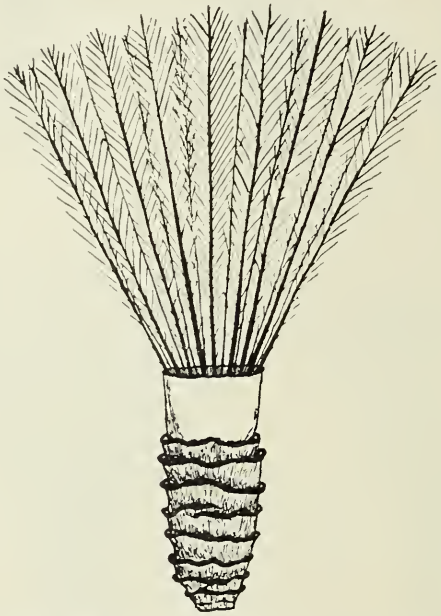

Fig. 6. *Elytropappus cyathiformis* DC. Drawn from the type specimen × 14.

extended study of the genus has shown that the same type of variation is present in *E. gnaphaloides* and *E. scaber*. In the writer's opinion such variations are non-specific in value. The character of the achene, an important diagnostic feature, remains unchanged in these variants.

A very variable character in the flower, best seen in the fruiting stage, is the so-called annulus. This in the majority of cases consists of a well defined rim around the top of the achene (figs. 3, 4), but occasionally it develops into a cup-like structure which is frequently termed the outer

[1] A Preliminary Note on the Rhenoster Bush and the Germination of its Seed. Margaret R. Levyns. Trans. Roy. Soc. S.Af. XIV (1926) p. 383.

pappus. This excessive development may be seen in *E. gnaphaloides* and *E. rhinocerotis* (fig. 5) where a rim-like annulus is the normal condition.

The known variability of this character in these widespread species renders the use of this character as a diagnostic feature in any species open to very serious objections. A case in point is *E. cyathiformis*, founded by De Candolle on a specimen collected by Drège with an unusually well developed annulus (fig. 6). This figure was drawn from the type specimen now at Geneva. Until recently this was the only plant known. A little further south in the same series of mountains Schlechter in 1897 collected a specimen identical with that of Drège excepting that it lacked this cup-like structure outside the pappus. There is a well-developed rim in the place of the cup in Drège's plant. Recently the writer collected a large number of plants of this species in the Cold Bokkeveld, not many miles from Schlechter's locality. All the Cold Bokkeveld specimens agree with that of Schlechter. In view of the known variability of this feature in other species the writer has emended De Candolle's description to include these southern forms in *E. cyathiformis*, which now unfortunately has a somewhat inappropriate name.

Distribution.

With the exception of *E. rhinocerotis* and possibly *E. adpressus*, the species of Elytropappus do not extend outside the boundaries of the south-western flora and are concentrated in the western part of the Cape Province. In this western concentration they agree with most other typical Cape plants that have been studied. Owing to their insignificant appearance and the fact that most of them flower in the autumn, a season much neglected by collectors, the records are rather scanty, and hence data for a full discussion of their distribution are not available.

E. rhinocerotis (the rhenoster bush), the one species which extends outside the limits of the south western flora, is remarkable in many ways. It has the aggressive habits of an alien and has often been regarded as such, though there are no foundations for this belief in the generally accepted sense. Within the south western districts it is largely confined to fine grained soils, covering large tracts of country. Owing to the dominance of this shrub such country is termed rhenosterveld. On the borders of the coastal belt and the karoo, rhenosterveld forms an interesting transitional zone which may be well seen near Ladismith in the Little Karoo. Here the kopjes to the South of the Klein Zwartberg run in an East and West direction. On the exposed northern slopes a succulent, karoid type of vegetation is present whereas on the southern slopes typical rhenosterveld is produced. The tops of the kopjes may or may not be crowned with a small strip of Cape flora. A little further East,

near van Wyk's Dorp, *E. rhinocerotis* appears to lose its dominant character and it appears as a normal constituent of vegetation that has not the general floristic features of the Cape flora, and shows a large admixture of eastern shrubs. It is possible that this type of habitat is the primitive one for *E. rhinocerotis* and that when it assumes an aggressive role it is actually an invader, and is therefore just as much an alien in those parts as if it had come from a foreign country.

In the Roggeveld at an altitude of about 4,000 feet *E. rhinocerotis* becomes less general in its distribution and for the most part is confined to the water courses. In such localities it sometimes reaches a height of 8 feet.

One of the striking features of this species is its plasticity. It succeeds in holding its own in both the summer and winter rainfall areas, and is equally at home in the mild coastal climate and in places where severe frosts are the rule during the winter months. There seems to be one factor, however, which provides a check on its distribution, and that is shade. How far the adult plant will tolerate shade is not known, but in the critical stages of seedling development even a small degree of shade is sufficient to kill off the young plants.

Acknowledgments.

I am much indebted to the Director of Kew for permission to work in the herbarium and for obtaining specimens on loan from various Continental herbaria. My thanks are due to the directors of the herbaria at Berlin, Geneva and Upsala for the loan of valuable type specimens without which this work could not have been completed. I have also consulted specimens in the British Museum, the Bolus Herbarium, the South African Museum Herbarium and the National Herbarium, Pretoria, and to the curators of these institutions I tender my thanks for the facilities they have afforded me. Mr. J. P. H. Acock has provided me with specimens from many localities and these have been most useful in studying the range of variability in certain species.

ELYTROPAPPUS Cass. in Bull. Soc. Philom. p. 199 (1816).

Capitula few (2-8) flowered, homogamous, discoid. *Involucral bracts* imbricate in few rows, the inner scarious, the outer sometimes woolly or leafy. *Receptacle* naked. *Florets* tubular and regular, usually inconspicuous. *Style branches* pencilled at the summit. *Achenes* beakless and sessile. *Pappus* of several bristles, plumose at the summit and usually united at the base to form a ring, usually with an external rim or, in a few cases, a cup-like outer pappus.

Branched shrubs, frequently glandular. Leaves usually small and ericoid.

An endemic South African genus. Species 8.

KEY TO THE SPECIES.

A. Capitula grouped in rounded, terminal heads.
  B^1. Leaves about 1 cm. long, with conspicuous spiny outgrowths .. .. 1. *hispidus.*
  B^1B^1. Leaves less than 1 cm. long, occasionally with a few glands but not with spiny outgrowths .. 2. *cyathiformis.*
AA. Capitula not grouped in rounded heads or if heads rounded then not all the capitula confined to the terminal position on the main shoots.
  B^2. Plants densely glandular.
    C^1. Pappus bristles free or nearly so, caducous .. 3. *longifolius.*
    C^1C^1. Pappus bristles firmly united at the base, not caducous.
      D^1. Capitula tightly packed in a spike-like inflorescence, rarely groups of capitula stalked. 4. *glandulosus.*
      D^1D^1. Capitula in loose heads, scattered on the upper parts of the branches .. .. .. 5. *scaber.*
  B^2B^2. Plants with a few scattered glands or none.
    C^2. Leaves tightly adpressed.
      D^2. Capitula spicately arranged at the apices of the branches, terminating the shoots; shoots for the next season's growth arising below the inflorescence; inner involucral bracts acute or sub-acute .. 8. *adpressus.*
      D^2D^2. Capitula lateral or terminal on side shoots, not terminating the growth of the main axes; inner involucral scales obtuse or sub-acute .. .. 7. *rhinocerotis.*
    C^2C^2. Leaves not tightly adpressed .. .. .. 6. *gnaphaloides.*

I. Elytropappus hispidus Levyns in Trans. Roy. Soc. S.A. XXIII p. 93 (1935). *E. spinellosus* Cass. Bull. Soc. Philom. p. 199 (1816) and Dict. Sci. Nat. XIV, p. 376 (1819); DC Prod. VI p. 256 (1837); Harv. in Fl. Cap. III p. 273 (1865); *E. spinulosus* Less. Syn. Comp. p. 343 (1832); *Gnaphalium hispidum* Linn. f. Suppl. p. 363 (1781); Thunb. Prod. p. 148 (1800); Thunb. Fl. Cap. ed. Schultes p. 645 (1823). *Metalasia hispida* Don. Mem. Wern. Soc. V. p. 558 (1826).

Bush about 30 cm. high, not much branched, glabrous or nearly so. *Leaves* linear, mucronate, closely set, erecto-patent, about 1 cm. long, covered with small spiny outgrowths. *Capitula* 6—8 flowered, several massed together in terminal rounded heads. *Involucral bracts* acuminate. *Ovary* scaberulous. Inner *pappus* well developed, outer *pappus* cup-shaped, entire.

No precise locality. *Thunberg*, Bockland!

2. Elytropappus cyathiformis DC. Prod. VI p. 257(1837) ; Harv. in Fl. Cap. III p. 273 (1865). *Cyathopappus metalasioides* Sch. Bip. in Pollichia XVIII-XIX p. 183 (1861).

Small shrub, rarely reaching 30 cm. in height, young branches woolly. *Leaves* woolly when young, the lower surface becoming more or less glabrous with age, linear, revolute, twisted, mucronate with a few, scattered, pedicellate glands. *Capitula* 3—7-flowered, several massed together and forming rounded heads at the ends of the branches. *Involucral bracts* all scarious, outer shorter and somewhat puberulous, especially along the midrib, inner glabrous, rather acute. *Corolla* 3—4 mm. in length, with a narrow tube and 5 narrow, spreading lobes, exceeding the involucral bracts. *Pappus* of about 18 well-feathered bristles, united at the base, sometimes with a very well developed cup-shaped outer pappus, but this latter structure may be absent. *Achene* 2—2.5 mm. in length, narrowed at the base, covered with deep, transverse wrinkles which may or may not extend as far as the annulus or outer pappus (fig. 6).

Clanwilliam : Cederberg, *Drège* 3676 ! Ceres : Tafelberg, *Schlechter* 10103 ! Cold Bokkeveld, *Levyns* 4887 ! 4919 !

3. Elytropappus longifolius (DC) Levyns. *E. glandulosus* Less. var. *longifolius* DC. Prod. VI, p. 256 (1837) partly ; Harv. Fl. Cap. III, p. 274 (1865). *Stoebe muricata* Sprgl. (ex. Sch. Bip. in Pollichia XVIII-XIX (1861).

Foliis longis, glandulas pedicillatas gerentibus ; spicis confertis, elongatis, foliosis ; pappo deciduo, setis basi subconcretis aut liberis ; annulo nullo ; achenio squamis deorsum imbricatis, superne obtectis.

Erect shrub, 1 m. high or less, with rather stiffly ascending branches. Young stems densely glandular and somewhat woolly. *Leaves* ericoid, reflexed, with an average length of 7—10 mm., longer in shade forms ; upper surface woolly, lower surface densely glandular-scabrid. *Capitula* 1 or 2 in the axils of the upper leaves, forming a rather dense spicate inflorescence. *Involucral bracts* few, loosely arranged and more or less of the same size, scarious or sometimes one or two of the outer leafy at the tip ; broad, obtuse, sometimes emarginate. *Florets* 3—6, slightly exceeding the involucral bracts. *Pappus* of several rather weak, plumose bristles, about three quarters of the length of the corolla, free or slightly joined at the base, falling off rather easily and when joined showing an uneven line of separation at the base. *Corolla* widening slightly from base to apex, with larger and more reflexed lobes than its immediate allies. *Achene* glabrous, tapering at both ends, without the rim (annulus) which usually characterises the genus, upper part covered with downwardly imbricate, irregular scales (fig. 1).

CAPE : Silvermine, *Pillans* 4341 ! *Levyns* 1440 ! Constantiaberg, *Salter* 280/17 ! WORCESTER : du Toit's Kloof, *Drège* ! CALEDON : Steenbras, *Galpin* 12563 ! Genadendal, *Burchell* 7615 ! *Burchell* 7879 ! *Drège* (49698 in S.A. Museum) ! *Levyns* 4836 ! *Levyns* 4837 ! WITHOUT LOCALITY : *Forsyth* !

NOTE.—This species differs from all others in the genus in the shape of the corolla, the weakly developed pappus, the absence of an annulus and the peculiar scale-like outgrowths on the upper part of the ovary. This being so it is strange that up to the present it has not been given specific rank.

There are three specimens at Kew collected by Burchell. Two of them are quoted by De Candolle as examples of *E. glandulosus* Less. var. *longifolius*, viz. 7615 from Genadendal and 7695 from Donker Hoek Mountains in the same district. The third specimen, Burchell 7879 from the same locality as 7615 is not quoted. 7615 is clearly a rather young stage of 7879 and this is the plant to which I now propose to give the name *E. longifolius*. Burchell 7695 is similar in vegetative features, but differs in characters of corolla, pappus and achene. It may be a hybrid between *E. longifolius* and *E. glandulosus*.

Two specimens which superficially look like this species, cannot be placed here. They are Phillips 1767 from the Great Winterhoek and Pillans 6795 from the Olifant's River Mountains. Both of these approach *E. gnaphaloides* in floral characters, but in vegetative features are quite unlike that species, their long leaves suggesting *E. longifolius*. *E. gnaphaloides* is present in both areas but there are no records of *E. longifolius*. The true nature of these plants must, therefore, remain uncertain until more is known of the species of Elytropappus which are growing in the neighbourhood in each case.

4. ELYTROPAPPUS GLANDULOSUS Less. Syn. Comp. p. 343 (1832). Harv. Fl. Cap. III, p. 274 (1865) partly. *E. glandulosus* Less. var. *microphyllus* DC. Prod. VI, p. 256 (1837) partly.

Shrub about 50 cm. high. Young stems slightly woolly, covered by the erect leaves excepting in sheltered habitats where the leaves may stand out from the stems. *Leaves* ericoid, average length 4—5 mm., upper surface woolly, lower surface densely covered with stalked glands. *Capitula* in the axils of the upper leaves, usually forming a narrow, spicate inflorescence, but occasionally with stalked glomerules. *Involucral bracts* scarious, the *outer* sometimes leafy and glandular at the tip, the *inner* occasionally rather woolly on the back, acuminate, about the same length as the florets. *Florets* usually 2, sometimes 3. *Pappus* well developed, persistent. *Corolla* narrow, tubular, with small erect or

slightly reflexed lobes. *Achene* with about 4 longitudinal ribs and a rim-like annulus.

Ceres : Cold Bokkeveld, *Levyns* 4898 ! Malmesbury : Riebeek Kasteel, *Levyns* 3108 ! Tulbagh : Witzenberg, *Burchell* 8653 ! Stellenbosch : Lourensford, *Pillans* (18285 in the Bolus Herbarium) ! Caledon : Genadendal, *Levyns* 4838 ! Swellendam : *Tradouw*, Mund and Maire !

5. Elytropappus scaber, Levyns in Trans. Roy. Soc. S. Af. XXIII, p. 93 (1935). *Elytropappus glandulosus* Less. var. *microphyllus* DC. (partly) (1837). *Stoebe scabra* Linn. f. Suppl. p. 391 (1781) ; Thunb. Prod. p. 170 (1800).

Fig. 7. *Elytropappus scaber* Levyns. Flower at the time of pollination (pappus removed) × 14.

Fig. 8. *Elytropappus scaber* Levyns. An older flower than that shown in Fig. 7. The top of the corolla is shrivelling and the lower part has become globose and fleshy × 14.

Divaricately branched, wiry shrub up to 1 m. in height, glandular-hispid. Young branches glandular, somewhat woolly near the nodes. *Leaves* ericoid, somewhat adpressed, occasionally slightly twisted, average length 2—4 mm., upper surface woolly, lower surface green, with stout scattered glands. *Capitula* in numerous, loose, rather rounded heads, 5—7 mm. in diam. in the fruiting stage, scattered on the upper parts of the branches, sessile or shortly stalked. *Involucral bracts* in 3 or 4 rows, loosely imbricate, outer rows leaf-like and glandular, the inner rows much longer, scarious, acute or acuminate. *Florets* usually 2, occasionally 3, about equalling the innermost bracts. *Corolla* becoming fleshy and globose at the base during senescence (figs. 7, 8). *Pappus* of about 16

plumose bristles with an inconspicuous annulus. *Style* becoming swollen at the base during senescence. *Achene* glabrous, with rather faintly marked longitudinal ribs.

CERES : Cold Bokkeveld, *Levyns* 4897 ! 4904 ! CAPE : *Ecklon* 608 ! Kenilworth, *Flanagan* 2425 ! Muizenberg, *Ecklon* 52 ! *Bolus* 4797 ! *Levyns* 4237 ! Kalk Bay, *Wolley Dod* 1006 ! Smitswinkel Bay, *Galpin* 12642 ! WORCESTER : Hex River, *Rehmann* 2680 ! CALEDON : Genadendal, *Levyns* 4859 ! BREDASDORP : Mierkraal, *Schlechter* 10507 (partly) ! WITHOUT LOCALITY : *Linnaeus* ! *Ecklon* 836 ! *Drège* !

NOTE.—*Schlechter* 10507 consists of plants most of which appear to be hybrids between *E. scaber* and *E. gnaphaloides*. The only undoubted specimen of *E. scaber* under this number is in the National Herbarium at Pretoria.

6. ELYTROPAPPUS GNAPHALOIDES Levyns in Trans. Roy. Soc. S.Af. XXIII, p. 94 (1935). *E. ambiguus* DC. Prod. VI, p. 256 (1837) ; *E. canescens* DC. loc. cit. *E. glandulosus* Less. var. *ambiguus*, Harv. Fl. Cap. III, p. 274 (1865). *E. glandulosus* Less. var. *pallens* DC. loc. cit. *Seriphium gnaphaloides* Linn. Mant. I, p. 481 (1770).

A much branched grey shrub, about 60 cm. high, with a more or less scanty covering of wool. Young branches woolly, with a few scattered glands. *Leaves* ericoid, patent, frequently twisted, woolly on upper and lower surfaces ; with a few, stout, scattered glands, average length 4—5 mm. *Capitula* singly or in clusters in the axils of the upper leaves, 5—7 mm. in diam. in the fruiting stage, sessile or stalked. *Involucral bracts* loosely imbricate in 3—4 rows, outer bracts small, leaf-like at the apex, which is woolly and glandular, inner rows much longer, scarious but with traces of wool, on the backs, acute, rarely somewhat acuminate. *Florets* usually 3, sometimes 2, about equalling the innermost bracts. *Corolla* becoming slightly fleshy at the base during senescence. *Pappus* of about 16 rather stout, plumose bristles, with an uneven, conspicuous rim outside, the degree of development of the latter being variable. *Achene* glabrous with several conspicuous, longitudinal ribs, these being most prominent on the inner face, very rarely with the ribs not conspicuous (fig. 4).

CLANWILLIAM : *Ecklon* 182 ! *Ecklon* 560 ! *Ecklon* 630 ! Wupperthal, *Drège* ! Olifants River, *Drège* 5684 ! CERES : Cold Bokkeveld, *Schlechter* 10210 ! *Levyns* 4927 ! MALMESBURY : Riebeek Kasteel, *Levyns* 3107 ! CAPE : Table Mountain, *Levyns* 4239 ! Mowbray, *Guthrie* 447 ! PAARL : Drakenstein, *Bolus* 4042 ! Dal Josaphat, *Tyson* 848 ! Bains Kloof, *Galpin* 12659 ! French Hoek, *C. A. Smith* 2645 ! WORCESTER : *Rehmann* 2633 ! 2634 ! du Toit's Kloof, *Drège* ! STELLENBOSCH : Kuils River, *Levyns*

4238 ! Sir Lowry Pass, *Burchell* 8242 ! *Schlechter* 7816 ! Caledon : Elgin, *C. A. Smith* 2579 ! Houw Hoek, *Levyns* 4872 ! Genadendal, *Levyns* 4857 ! Greyton, *Levyns* 4866 ! Bredasdorp : Mierkraal, *Schlechter* 10507 (partly) ! Mossel Bay : Herbertsdale, *Muir* 2062 ! Uniondale : Lauterwater, *Compton* 4228 ! Without Locality : *Linnaeus* ! *Ecklon* ! *Mund* ! *Sieber* !

7. Elytropappus rhinocerotis Less. Syn. Comp. p. 344 (1832). DC. Prod. VI, p. 256 (1837) ; Harv. Fl. Cap. III, p. 274 (1865). *Stoebe rhinocerotis* Linn. f. Suppl. p. 391 (1781) ; Thunb. Prod. p. 170 (1800). *S. cernua* Thunb. Prod. p. 170 (1794). *S.cupres sina* Reichb. in Sieber. Pl. exs. Cap 18 (ex DC. Prod. VI p. 257). *Seriphium Rhinocerotis* Pers. Syn. II p. 501 (1807). *S. cernuum* Pers. loc. cit.

A much branched grey or grey-green shrub, from 60 cm. to 2.5 m. high. Young stems shortly and densely woolly, covered with numerous, small adpressed leaves. *Leaves* minute, obtuse, closely adpressed to the stem, woolly on the upper surface, glabrous or shortly woolly below. *Capitula* grouped near the apex of lateral branches which may be short or long and cernuous, each capitulum usually with 3 florets. *Involucral bracts* scarious, sometimes shortly woolly outside, obtuse, or rarely subacute, the innermost row a little shorter than the florets. *Florets* tubular with small lobes. *Pappus* well developed. *Achene* with a few longitudinal ribs which are sometimes very conspicuous, and with a pronounced rim-like annulus which occasionally develops into a cup-like outer pappus (fig. 5).

Namaqualand : O'okiep, *Levyns* 1492a ! Clanwilliam : Zeekoe Vlei, *Levyns* 1215 ! Ceres : Cold Bokkeveld, *Levyns* 4913 ! 4925 ! Malmesbury : Groenkloof, *Pillans* 6329 ! Riebeek Kasteel, *Levyns* 3105 ! Tulbagh : *Burchell* 1025 ! Witzenberg, *Burchell* 8730 ! Cape : Cape Flats, *Burchell* 159 ! *Pappe* ! Cape Town, *Levyns* 2679 ! Paarl : *Drège* ! Stellenbosch : *Burchell* 8730 ! *Levyns* 1443 ! Sir Lowry Pass, *Ecklon* and *Zeyher* ! Robertson : Kogman's Kloof, *Levyns* 70 ! Riversdale : *Levyns* 3071 ! Ladismith : Seven Weeks Poort, *Phillips* 1455 ! van Wyksdorp, *Levyns* 2635 ! Laingsburg : Matjesfontein, *Levyns* 1442 ! Sutherland : *Levyns* 3074 ! Oudtshoorn : Gamka River, *Bowker* ! Prince Albert : Zwartberg Pass, *Pocock* S. 37 ! Great Zwartberg, *Drège* ! *Burtt Davy* 12725 ! Murraysburg : *Tyson* 335 ! Graaff Reinet : *Burtt Davy* 13477 ! Somerset East : *Burchell* 3268 ! Uniondale : Long Kloof, *Burchell* 4899 ! Albany : Grahamstown, *Rennie* 272 ! Without Locality : *Miller* !

8. Elytropappus adpressus Harv. Fl. Cap. III, p. 274 (1865).

A low shrub usually less than 30 cm. high, with whip-like branches. Young stems woolly. *Leaves* ericoid, closely adpressed to the branches, average length about 2 mm., woolly when young but becoming glabrous with age. *Capitula* one to several near the tips of the shoots, terminating their growth, subsequent development taking place by means of lateral branches arising below the inflorescence. *Involucral bracts* in several rows, scarious, innermost row sharply acute, about equalling the florets. Characters of *floret* and *achene* as for *E. rhinocerotis*.

Ceres : Cold Bokkeveld, *Levyns* 4228 ! 4903 ! 4926 ! Worcester : The Koo, *Levyns* 3898 ! Caledon : *Burchell* 7815 ! *Levyns* 4856 ! Laingsburg : Witteberg, *Compton* 2983 ! Uniondale : Long Kloof, *Fourcade* 3827 ! Exact division uncertain (possibly Graaff Reinet): Klipdrift, Great Karoo, *Schlechter* 2283 !

Note.—This species was founded by Harvey who suggested that it might be the same thing as *Seriphium adpressum* DC. I have seen Burchell 7573, quoted by De Candolle as *S. adpressum*. Whatever that plant may be, it is not the same thing as *Elytropappus adpressus* Harv. Harvey quotes no actual specimen but his description fits the plants quoted above.

According to Mr. A. Jooste of Houdenbek, in the Cold Bokkeveld, this plant is known to farmers as the " wyfie " rhenoster. It has not the aggressive habits of the rhenoster bush and may be grazed by stock in times of drought.

NEW COMPOSITAE FROM THE TRANSVAAL.

by

J. Burtt Davy.

The elaboration of the large family Compositae, with its 108 Transvaal genera, for the *Flora of the Transvaal* has been completed, but the MS. awaits facilities for publication. The work has brought to light a number of new species and varieties. Delay in the publication of their descriptions causes inconvenience to students, and as it is uncertain how soon the rest of Volume II of the *Flora* can appear, it seems best to publish them independently.

Through the courtesy of the Editor of the Journal of South African Botany and of the Director of the Royal Botanic Gardens, Kew, arrangements have been made to describe part of the new species at Cape Town, and part in the *Kew Bulletin*.

TRIBE SENECIONEAE.

Euryops discoideus Burtt Davy sp. nov.; ab *E. Gilfillanii* Bolus, cui affinis, foliis applanatis nec teretibus nec canaliculatis, apice acutis, basi haud lanatis, capitulis disciformibus nec radiatis distinguitur.

Herba nana perennis. *Folia* integra linearia, usque ad 7.5 cm. longa, 0.15 cm. lata, scabrata, acuta, basi glabra, margine infra medium hispida. *Pedunculus* gracillimus striatus, usque ad 20 cm. longus. *Capitulum* solitarium, 8 mm. latum; flores radii 0, *Involucri bracteae* circiter 5 mm. longae, 3 mm. latae, striatae.

Transvaal. Barberton District: Kaapsche Hoop, alt. 4,000 ft., November, *Rogers* 21275 in herb. Kew (*type*).

Euryops Rogersii Burtt Davy sp. nov.; affinis *E. pedunculato* N. E. Br., sed foliis patentibus densissime dispositis basin versus haud ciliolatis, involucri bracteis obtusis (nec acuminatis) differt.

Suffrutex nanus ramosus; rami erecti densissime foliati. *Folia* trifida, circiter 1.5 cm. longa, dense atque spiraliter disposita, patentia vel plus minusve reflexa, ad basin haud ciliolata, costa cum nervis 2 lateralibus persistentibus ut rami spinis rigidis erectis obtegantur. *Pedunculi* 3—8 terminales, 11—13 cm. longi, leviter striati vel laevigati. *Involucrum* 1 cm. latum; bracteae ad basin modo connatae, multinervosae, apicem obtusum versus abrupte angustatae. *Flores radii* ligula circiter 11 mm. longa, 2.5 mm. lata.

Transvaal. Barberton District: Kaapsche Hoop, November, *Rogers* 21444 (*type*)

An ornamental plant slightly resembling some forms of *E. abrotanifolius*.

TRIBE ANTHEMIDEAE.

Eriocephalus hirsutus Burtt Davy sp. nov.; affinis *E. glabro* Thunb., sed foliis et involucri bracteis dense fulvo-hirsutis distinguitur.

Suffrutex lignosus usque ad 20 cm. (vel ultra ?) altus. *Folia* minuta 4—5 mm. longa, linearia, teretia, dense fulvo-hirsuta, in ramulis brevissimis cicatricosis fasciculata. *Inflorescentia* laxe corymbosa, omnino dense fulvo-hirsuta; bracteae ad 3 mm. longae. *Capitula* solitaria vel pauca, 3 mm. diametro; pedicellus ad 3 mm. longus. *Involucri bracteae* ovatae, 3.5 mm. longae, 1.5 mm. latae, dense fulvo-hirsutae.

Transvaal. Waterberg District: at Klippan, *Rehmann* 5232 in herb. Kew (*type*).

An interesting northerly extension of the genus, which is largely represented in the Karroo, Namaqualand, and the South-Western Cape. *E. glaber* Thunb. occurs in Natal.

A species (*E. aspalathoides* ?) found in the Kuruman Division, British Bechuanaland, is known as "Kapok-bos" or "Snow-bush," and is stated to be "good for all kinds of live-stock."

TRIBE CALENDULEAE.

Osteospermum striatum Burtt Davy sp. nov.; affine (ut videtur) *O. caulescenti* Harv., sed caule simplice nec ramoso, achaeniis alatis differt.

Herbae caudex perennis, lignosus, haud foliatus; caulis erectus annuus simplex, alte striatus, ad 10 cm. altus, primum tomentosus demum glabrescens. *Folia* scabrida sessilia, lineari-lanceolata, inferiora 1—1.5 cm. superiora ad 4.5 cm. longa, 0.3—0.5 cm. lata, apice acuta, basin versus vix angustata, costa cum nervis parallelis et supra et subtus prominentibus. *Capitulum* solitarium; pedunculus pubescens striatus, circiter 8 cm. longus. *Involucri bracteae* striatae, pubescentes, usque ad 8 mm. longae, ovato-lanceolatae, apice acuminatae. *Flores radii* 1 cm. longi, 0.5 cm. lati; *flores disci* ad 8 mm. longi. *Achaenia* alata.

Transvaal. Barberton District: Kaapsche Hoop, September, *Wager* 15571 in herb. Kew (*type*). Carolina District: Waterval Onder, October, *Rogers* 5937.

TRIBE INULEAE.

Gnaphalium Nelsonii Burrt Davy sp. nov. ; inter species austro-africanas caulibus altis erectis rigidis perennibus, foliis utrinque albo-tomentosis haud decurrentibus, involucri bracteis brunneo-flavescentibus distinctum.

Herba perennis ; caules e basi ascendente erecti, rigidi, 17—25 cm. alti, dense imbricate foliati, superne ramosi. *Folia* sessilia, erecta vel ascendentia, 1 cm. longa, 0.2 cm. lata, linearia, apice acuta, utrinque albo-tomentosa. *Inflorescentia* globosa vel ramosa. *Capitula* circiter 10 subsessilia, 2.5—3 mm. longa, 3 mm. lata. *Involucri bracteae* anguste ellipticae, brunneo-flavescentes.

Transvaal. Pretoria District : Vander Walt, "in native mealie gardens" August, *Nelson* 289 in herb. Kew (*type*).

Helichrysum andersoniense Burtt Davy sp. nov. ; ab *H. calocephalo* Schltr., cui affine, capitulo solitario differt ; affine *H. albissimo* Marl., sed foliis longioribus oblanceolatis laxius imbricatis minus lanatis, caule decumbente, involucri bracteis brevioribus exterioribus haud candidis differt ; ab *H. adenocarpum* DC. capitulis multo majoribus, involucri bracteis multiseriatis, caule et ramis lignosis, ramulis floriferis brevibus validis distincta.

Caulis lignosus perennis, decumbens vel ascendens, ramosus ; ramuli dense foliati. *Folia* patentia sessilia, circiter 4 cm. longa, 1.8 cm. lata, oblonga vel oblanceolata, apice obtusa, basi late amplexicaulia, supra scabrida vel plus minusve floccosa, subtus leviter cinereo-lanata ; nervi 3 prominentes. *Pedunculi* 4—5 cm. longi ; bracteae foliaceae. *Capitula* solitaria, circiter 4 cm. lata. *Involucri bracteae* 6—8-seriatae, ad 2 cm. longae, apicem acutum versus angustatae, exteriores minute scaberulae purpureo- vel brunneo-suffectae, interiores lucentes candidae.

Transvaal. Lydenberg District : summit of Mount Anderson, September 1919, *Rogers* 22990 in herb. Kew (*type*).

Helichrysum brunneum Burtt Davy sp. nov. ; *H. gerberaefolium* Oliv. et Hiern., Fl. Trop. Afr. 3, 353 pro parte, non Sch. Bip. ; affine *H. gerberaefolio* Sch. Bip., sed foliis caulinariis pluribus latioribus, inferioribus basi subauriculatis (nec angustatis), involucri bracteis manifeste albo-lanatis differt ; affine *H. leiopodio* DC., sed foliis caulinariis haud reductis, quam internodia multo longioribus differt.

Caulis perennis erectus, circiter 70 cm. altus, striatus, leviter floccosus, superne sparse foliis parvis vel bracteis foliaceis vestitus ; internodia 6.5—9 cm. longa. *Folia* ascendentia, internodiis longiora, 11—13.5 cm.

longa, 2.3—2.5 cm. lata, oblonga, apice obtusa vel acuta, basi subauriculata late amplexicaulia, supra leviter floccosa vel glabrescentia, subtus dense cinereo-lanata, margine integra. *Cyma* corymbosa ramosa 5—6 cm. lata. *Capitula* subsolitaria ; pedunculi circiter 0.5 cm. longi. *Involucrum* fuscum campanulatum, supra medium constrictum, circiter 6 mm. longum, 5 mm. latum ; *bracteae* ad basin albo-lanatae, aureo-brunneae, superne glabrae plus minusve rugulosae, apice saepius acutae.

Transvaal. Pietersburg District : Shilouvane, *Junod* 1632 in herb. Kew (*type*).

Specimens collected by Kirk in Portuguese East Africa, near Satohi, 3,500 ft. alt., October 1859, and in Nyasaland on Mt. Mlanje, by Whyte, appear to belong here.

Helichrysum flavum Burtt Davy sp. nov. ; affine *H. subglomerato* Less., sed foliis lineari-subulatis laxe floccoso-lanatis (nec pilis implexis argenteis obtectis), et pedunculis tenuioribus sparse bracteatis differt ; ab *H. oligopappo* Bol., foliis acuminatis erectis vel ascendentibus, haud pilis implexis argenteis obtectis distinguitur.

Suffrutex : rami numerosi, circiter 25 cm. alti, e caule foliato decumbente ascendentes, pedunculo sparse bracteato terminati. *Folia* ascendentia imbricata persistentia, inferiora superioribus vix dissimilia, 1.5—2 cm. longa, 0.3 cm. lata, lanceolata vel lineari-subulata, acuminata, basi amplexicaulia, supra juventute floccosa demum glabrescentia, subtus leviter cinereo-lanata, margine revoluta. *Cymae* circiter 1.5 cm. latae. *Capitula* in receptaculo applanato subtus lanato congesta, circiter 3 mm. longa, 1 mm. lata, aureo-flavescentia.

Transvaal. Barberton District : White River, April, *Rogers* 20144 in herb. Kew (*type*).

Helichrysum Galpinii N.E.Br. var. **tenuius** Burtt Davy var. nov. ; a typo ramulis elongatis tenuioribus nec foliis marcescentibus vestitis, pedunculis 2—3 cm. longis, et involucri bracteis minus lanatis differt.

Transvaal. Lydenburg District : Belfast, among granite rocks, alt. ca. 6,500 ft., December, 1905, *Bolus* 11970 in herb. Kew (*type*).

Helichrysum infuscum Burtt Davy, sp. nov. ; affine *H. appendiculato* Less., sed involucri bracteis brunneis vel purpurascentibus basi albolanatis differt.

Herba nana perennis circiter 9—12 cm. alta : caulis solitarius (?), ascendens vel suberectus, basi circiter 3 mm. diametro, imbricate foliatus. *Folia rosellae basalis* cinereo-lanata, 3.5—4 cm. longa, 1.7—2 cm. lata, oblonga vel oblanceolata, apice obtusa, basi amplexicaulia. *Folia caulinaria* ascendentia, imbricata, dense lanata, circiter, 2.5 cm. longa,

0.8 cm. lata, lanceolata, apice acuta. *Inflorescentia* densa capitata globosa, praeter folia paullo exserta, circiter 2 cm. lata. *Capitula* subsessilia, circiter 8 mm. longa, 6 mm. lata, campanulata, fusca. *Involucri bracteae* gilvae, ad apicem brunneae vel purpurascentes, basi albo-lanatae, exteriores acutae, interiores obtusae mucronulatae.

Transvaal. Pietersburg District: The Downs, alt. 4,000 ft., December, *Rogers* 21959 in herb. Kew (*type*).

Helichrysum pullulum Burtt Davy sp. nov.; affine *H. cymoso* Less., sed foliis densius dispositis, basi auriculatis, et involucri bracteis fulvis (nec aureis) differt; ab *H. revoluto* Less., inflorescentia sub-globosa, capitulis paucioribus minoribus distinctum.

Suffrutex lignosus circiter 30 cm. altus; caules ramosissimi, basi circiter 2 mm. diametro; rami usque ad apicem foliati, internodiis dense cinereo-lanatis circiter 0.5—0.75 cm. longis. *Folia* inferiora decidua vel marcescentia; superiora ascendentia, circiter, 2 cm. longa, 0.3 cm. lata, lineari-lanceolata, integra, apice acuta, basi auriculata amplexicaulia, utrinque subtomentosa incano-virescentia vel supra glabrescentia. *Inflorescentia* capitata vel ramosa, globosa, 1.5—2 cm. lata. *Capitula* pauca vel compluria, parva, 3 mm. longa, 2—3 mm. lata, subturbinata, fulva. *Involucri bracteae* multiseriatae adpressae vel apice subsquarrosae.

Griqualand East. Umzimkulu Division: Umzimkulu River at Handcock's Drift, alt. 2,500 ft., December, *Tyson* 3086 in herb. Kew (*type*).

Natal. Utrecht Division: near Charlestown, *Medley Wood* 5722; without precise locality, *Medley Wood* 3611 and 3621.

Transvaal. Heidelberg District: Greylingstad, *Rand* in herb. Brit. Mus. 1318.

Helichrysum subluteum Burtt Davy, sp. nov.; affine *H. latifolio* Thunb., sed caulibus plus minusve imbricate foliatis, et involucri bracteis luteis differt; ab *H. pedunculare* DC., caulibus foliis et capitulis valde minoribus, et involucri bracteae luteis distinctum.

Herba perennis; caules e foliorum rosella basali oreintes, foliis reductis imbricatis vel bracteis foliaceis vestiti; internodia 2.5—4 cm. longa, dense adpresso-cinereo-tomentosa. *Folia basalia* integra, circiter 5 cm. longa, 1.5 cm. lata, oblonga, apice obtusa vel acuta, basi late amplexicaulia, supra subglabra subprominenter 5-nervia, subtus pelli argentea separabili tecta. *Folia caulinaria* erecta, internodiis saepius breviora, 2.5—3.5 cm. longa, 0.4 cm. lata, lineari-lanceolata, apice acuta, basi amplexicaulia, leviter floccosa. *Inflorescentia* capitata globosa, circiter 2 cm. lata. *Capitula* pauca, circiter 6 mm. longa, 7 mm. lata, campanulata, subsessilia, fulva. *Flores* in sicco brunnei. *Involucri bracteae*

pallide luteae, apicem versus fuscae, lanceolatae vel oblongae, exteriores acutae, interiores obtusae vel mucronulatae.

Transvaal. Pietersburg District: Woodbush Hill, November, *Leendertz-Pott* 4532 in herb. Kew (*type*). Lydenburg District: near Lydenburg, *Atherstone* sine numero, in herb. Kew.

Helichrysum truncatum Burtt Davy sp. nov.; affine *H. campaneo* S. Moore et *H. aureo-nitenti* Sch. Bip., sed foliis caulinariis supernis apicem truncatum versus brunneo-scariosis differt.

Herba perennis circiter 20 cm. alta; caules 2—3, arcuatim ascendentes, basi circiter 1 mm. diametro, omnino imbricate foliati. *Folia basalia* caespitosa, dense argenteo-tomentosa, integra, 3—4 cm. longa, 0.4—0.5 lata, anguste lanceolata vel lineari-lanceolata, apice acuta. *Folia caulinaria* angustiora, 1—2 cm. longa, linearia vel subulata, erecta, imbricata, inferiora apice acuta, superiora ad apicem truncatum brunneo-scariosa, in bracteas involucrales sensim abeuntia. *Inflorescentia* densa capitata globosa, circiter 2 cm. lata. *Capitula* sessilia vel subsessilia, 5 mm. longa, 2 mm. lata, fusca. *Involucri bracteae* brunneo-pellucidae, apice rotundatae, ad basin albo-lanatae.

Transvaal. Lydenberg District: Devil's Knuckles, between Lydenburg and Spitzkop, March, *Wilms* 739 in herb. Kew (*type*).

Helichrysum uninervium Burtt Davy sp. nov.; affine *H. callicomo* Harv., sed foliis acutis breviter petiolatis, capitulis majoribus, et involucri bracteis recurvis vel subsquarrosis differt.

Suffrutex virgatus; rami foliati tenues, circiter 30 cm. longi, basi circiter 1.5 mm. diametro, leviter adpresso-tomentosi. *Folia* ascendentia vel patentia, 1.5 cm. longa, 0.3—0.4 cm. lata, oblanceolata, breviter petiolata vel subsessilia, basin versus angustata, apice acuta vel mucronulata, et supra et subtus prominenter uninervia tomento olivaceo-virescente obtecta. *Inflorescentiae* corymboso-cymosae paucicapitulatae, 2—3.5 cm. latae, in ramulis terminales. *Capitula* pedunculata flava, 6—8 mm. longa, 2—3 mm. lata, turbinata. *Involucri bracteae* lanceolatae, acuminatae, apice subsquarrosae vel recurvae, exteriores fulvae gossypinae, interiores flavae glabratae.

Transvaal. Lydenburg District: Pilgrim's Rest, *Rogers* 18000a, in herb. Kew (*type*).

PLANTAE NOVAE AFRICANAE.

" Ex Africa semper aliquid novi."—*Pliny.*

SERIES III.

By

T. M. Salter and R. H. Compton.

With Text Figures drawn by T. M. Salter and Miss W. F. Barker.

Oxalis furcillata, Salter (Oxalidaceae), § Tripartitae (Bifurcatae).

Planta parva subglauca, acaulis vel rare caule ad 1 cm. exserto, 6—8 cm. alta. *Partes herbaceae* (nisi tamen pedunculi) pilis longis patentibus hyalinis pluricellularibus pilosae. *Bulbi* saepe congesti, oblongo-ovoidei, ad 3 cm. longi, tunicis tenuibus numerosis, exterioribus rugosis, praecipue ad basin undulatis, interioribus lanceolatis, apice acicularibus, planis. *Rhizoma* ad 15 cm. longum, rare minute viscoso-pilosum, squamis oblongis semiamplexicaulibus brunneis indutum. *Caulis*, sicut rhizoma, squamosus. *Folia* numerosa vel numerosissima, ad apicem caulis dense conferta, tanquam pseudo-rosulata : petioli ad 2 cm. longi, satis dense pilosi, exteriores breviores vel squamosi, ad basin manifeste articulati, infra articulum in squamis oblongis carinatis dilati : foliola 3, sessilia, basi cuneata, plus minusve ad medium biloba, 8—12 mm. longa, lobis lineari-oblongis subobtusis, supra glabra, infra, praecipue in nervo mediale, pilosa, dense vel sparse ciliata, subglauca. *Pedunculi* uniflori, saepe numerosi, e axillis foliorum exorientes, folia superantes, 2.5—3.5 cm. longi, glabri, post anthesin deflexi, ad apicem bibracteati bracteis linearibus alternantibus, ad 1.5 mm. longis. *Sepala* anguste ovata vel oblonga, obtusa, 4—5 mm. longa, subpellucida, pilosa, ecallosa, interdum striis parvis purpureis sparse notata. *Corolla* glabra, alba (in siccis saepe pallide lutea), 1.6—2.0 cm. longa, tubo breve, lato-infundibuliforme luteo : petala oblique cuneata, apice oblique truncata, 0.9—1.2 cm. lata, ad marginem exteriorem striis parvis numerosis atro-violaceis ornata. *Filamenta* (parte connata inclusa) exteriora 2.5—4 mm. longa, glabra, interiora 3.5—7 mm. longa, glanduloso-pubescentia, breviter obtuseque dentata. *Ovarium* ovato-oblongum, 1.5—2 mm. longum, superne glanduloso-pilosum, stylis glandulosis, stigmatibus, in forma longistylosa 0.5 mm. longis, caeteris 0.15 mm. longis. *Capsula* globosa, loculis, 2-ovulatis.

Var. β. **caulescens.** *Caulis* productus, rare ramosus; *petioli* breviores; *pedunculi* saepe manifeste caulini.

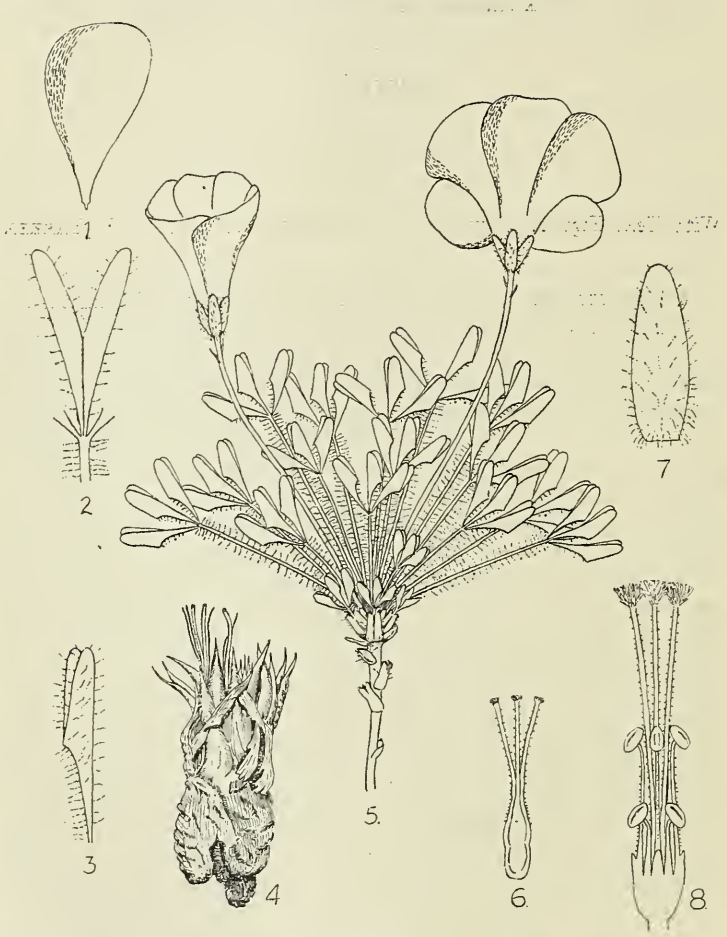

Fig. 1. *Oxalis furcillata* Salter. 1. Petal × 1½. 2. Medial leaflet, upper side (open) × 3. 3. Ditto, under side × 3. 4. Bulb cluster, natural size. 5. Plant × 1½. 6. Gynaecium × 8. 7. Sepal × 6. 8. Androecium × 8.(*Salter* 2576.) *Del.* T. M. Salter.

Hab. Namaqualand; Misklip, flowers June-July, *Salter* 2576 (type); 13 miles south of Steinkopf, 2593; 2 miles north of Concordia, 4580.

Var. β, about Kamieskroon, *Salter* 854 (type) 890, 1412, 1484, 2559, 4570 and 4607. Both types are in the Bolus Herbarium.

An affinity of *O. densa*, N.E.Br., but a larger plant in every way and lacking the moss-like appearance of that species. It also differs in having much longer peduncles, leaflets glabrous on the upper surface, long rather inconspicuously pluricellular hairs and dentate inner filaments. Variety β, which has a rather more southern distribution, is smaller, sometimes with a dense tuft of short leaves at the apex of a well-produced stem, while other specimens, especially those cultivated, have an elongate leafy stem, cauline peduncles and a habit approaching that of the section Sessilifoliolatae. (v.v.s., v.v.c.)

Oxalis inconspicua, Salter (Oxalidaceae), § Tripartitae (Rotundatae).

Planta parva gracillima, ad 6 cm. alta, partibus herbaceis omnino glabris, caule non exserto. *Bulbus* ovoideus, fere 1.5 cm. longus, tunicis acuminatis, exterioribus atro-brunneis, laevigatis, rare pinnato-nervatis. *Rhizoma* gracile, 2—3 cm. longum, sicut radiculis minute pilosum, squamis parvis sparse instructum. *Folia* 6—16, basalia, prostrata : petioli 1—2 cm. longi, basi (infra articulum) squamiformes, superne teretes : foliola 3, medium brevissime petiolulatum, lateralia sessilia, late cuneato-obcordata vel rotundato-obcordata, 3—7 mm. longa, 4—9 mm. lata, infra callis oblongis brunneis abunde punctata. *Pedunculi* uniflori, 3—5 cm. longi, ad basin articulati, in dimidio superiore bibracteati bracteis linearibus minutis. *Sepala* ovato-lanceolata, acuta, 1.5—2.5 mm. longa, callis elongatis aurantiacis, praecipue in dimidio superiore, longitudinaliter induta. *Corolla* 1—1.4 cm. longa, alba, tubo luteo, anguste subcyathiforme, ad basin leviter constricto : petala e basi unguiculata anguste cuneata, superne oblique obovata, margine exteriore inferiore anguste purpureo-tincta, ad marginem anteriorem interdum aurantiaco-callosa. *Filamenta* minutissime glandulosa, (parte connata inclusa) exteriora 1.5—3 mm., interiora 2.5—5.5 mm. longa, dentibus acutis, 0.6—0.8 mm. longis, instructa, longissima ad apicem reflexa. *Ovarium* ovoideum, 1—1.5 mm. longum, glabrum vel superne cum stylis minute glanduloso-pilosum, in dimidio superiore callis aurantiacis (in siccis atro-brunneis) conspicue ornatum, loculis 2—3-ovulatis. *Capsula* globosa.

Hab. Namaqualand : Kamieskroon, 6 June 1931, *Salter* 817 (type in Bolus Herbarium) ; near Steinkopf, July, 1932, *Salter* 2590.

This species, although the leaflets are somewhat obcordate, seems to be best included in the section *Rotundatae* with its nearest affinity

O. minima, Sond. It has, however, a simple bulb with hardish brown tunics, not as in *O. minima** embedded in a copious mass of soft loose scales, a longer peduncle, narrower sepals, a longer and differently shaped corolla tube, and much longer and more acute teeth on the inner filaments. The plant from near Steinkopf (2590) is rather larger in all respects, but indistinguishable in cultivation. (V.V.S., V.V.C.)

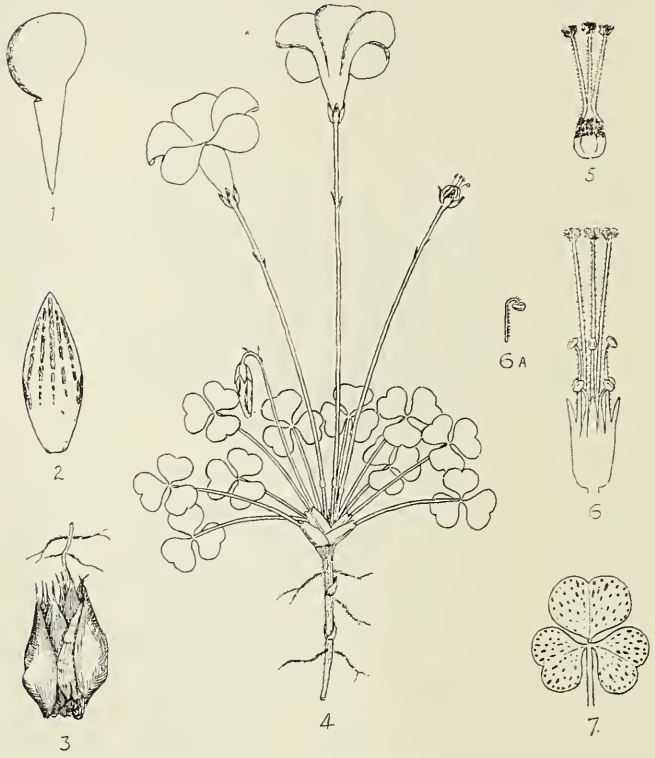

FIG. 2. *Oxalis inconspicua* Salter. 1. Petal × 2. 2. Sepa × 10. 3. Bulb × 1½. 4. Plant × 1½. 5. Gynaecium × 8. 6. Androecium showing long styles × 8. 6A. Apex of inner filament in medio- and brevistyled forms × 8. 7. Leaf, under surface × 3. (*Salter* 817.) *Del.* T. M. Salter.

* Zeyher apparently did not collect the bulb of *O. minima*, Sond. (*Zey.* 237 !) as Sonder makes no mention of it. The bulb described by R. Knuth (Pflanz. Oxal. p. 355) as "ovate, black" is probably that of *O. luteola*, Jacq. (*Schlechter* 7931 !) which has been wrongly attributed to *O. minima*.

Oxalis deserticola, Salter (Oxalidaceae), § Tripartitae (Glandulosae). *Planta* erecta 5—18 cm. alta, caule exserto. *Partes herbaceae* pilis patentibus hyalinis pluricellularibus capitatis pilosae. *Bulbus* late

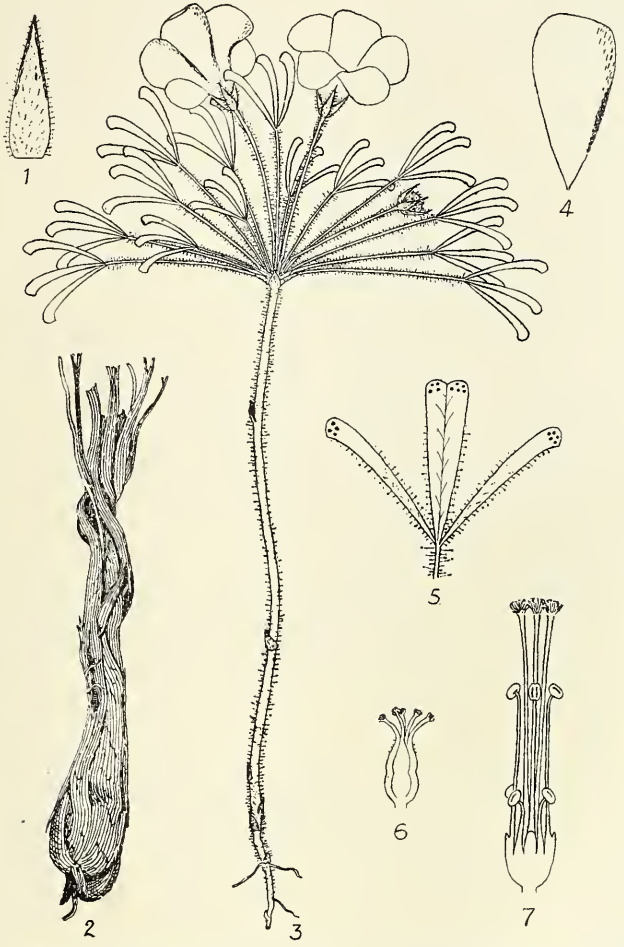

Fig. 3. *Oxalis deserticola* Salter. 1. Sepal × 4. 2. Bulb, natural size. 3. Plant, natural size. 4. Petal × 1½. 5. Leaf, showing upper side of medial leaflet × 2. 6. Gynaecium × 6. 7. Androecium × 6. (*Salter* 711.) *Del.* T. M. Salter.

subuloideus, fere 8 cm. longus, ad basin 1 cm. latus in parte superiore tortuosus, tunicis ligulatis longitudinaliter costatissimis, inferne defissis,

quasi fibrosis, pallide brunneis. *Rhizoma* breve, squamis paucis cuspidatis semiamplexicaulibus induta. *Caulis* simplex, ad 10 cm. longus, sicut rhizoma squamis paucis instructus. *Folia* ad 18, apice caulis conferta, petiolis gracilibus, 1—2.5 cm. longis, basi (infra articulum) dilatis, squamiformibus, nervatis ; foliola 3, sessilia, lineari-cuneata, conduplicativa, leviter emarginata, 0.7—1.6 cm. longa, 1—3.5 mm. lata, superne plus minusve falcata, callis 3—20, parvis inconspicuis brunneis notata, ciliata, supra glabra, saepe glauca, infra, praecipue in parte inferiore et in nervo mediale, pilosa. *Pedunculi* uniflori, apice caulis aggregati, rare e squamis inferioribus exorientes, 0.5—2 cm. longi, fere foliis breviores, ad basin sicut petioli dilati, ad apicem bibracteati bracteis filiformibus alternantibus, fere 2 mm. longis. *Sepala* lanceolata vel lato-lanceolata, attenuata, acuta, 5—7 mm. longa, ad marginem striis purpureis parvis saepe notata. *Corolla* 1.5—2.4 cm. longa, alba, tubo breve late infundibuliforme luteo, striis 5 purpureis saepe longitudinaliter induto : petala cuneata, interdum ad basin leviter attenuata, apice oblique subtruncata, striis parvis purpureis ad marginem exteriorem plus minusve ornata. *Filamenta* (parte connata inclusa) 2—4 mm. et 4—7.5 mm. longa, glabra, interiora breviter obtuseque dentata. *Ovarium* anguste ovoideum, fere 1.5 mm. longum, glabrum vel superne sparse glandulosum, stylis glabris. *Capsula* globosa, loculis 2—3-ovulatis.

Hab. Cape Province : Van Rhyn's Dorp Div. ; 16 miles north-east of Van Rhyn's Dorp, flowers May—June. *Salter* 711 (*type* in Bolus Herbarium) and 2493.

This species is intermediate between the sections Glandulosae and Xanthotriche, but differs from all others in those sections in having very prominently ribbed bulb scales. It seems to be a very rare plant having only been found in the locality quoted, in hard stony ground. The plants are variable in size in all parts.

Oxalis suteroides, Salter (Oxalidaceae), § Tripartitae (Glandulosae).

Planta caulescens erecta, ramosa, ad 25 cm. alta, partibus herbaceis pubescentibus et pilis brevibus pluricellularibus capitatis admixtis plus minusve pilosis. *Bulbus* subuliformis, saepe tortuosus, ad 7 cm. longus, tunicis tenuibus undulatis brunneis. *Rhizoma* cortice papyraceo brunneo obtectum, squamisque amplexicaulibus cuspidatis obsitum. *Caulis* rigidus, ad 1 mm. latus, saepe ramosus, sicut rhizoma squamis obsitus. *Folia* petiolata, ad apicem caulis ramorumque conferta, satis numerosa, rarius caulina, petiolis 0.75—1.5 cm. longis, capillaribus : foliola 3, breviter petiolulata, lineari-cuneata vel oblongo-cuneata, interdum conduplicativo-falcata, emarginata, 5—7 mm. longa, 1—2 mm. lata, supra glabra, infra pubescentia, in nervis medialibus marginibusque pilis paucis

capitatis pilosa. *Pedunculi* uniflori, saepe numerosi, folia superantes, ad apicem caulis aggregati, rarius e squamis inferioribus evolventes, post

FIG. 4. *Oxalis suteroides* Salter. 1. Corolla × 1½. 2. Corolla of var. β × 1½. 3. Bulb, natural size. 4. Petal × 2. 5. Leaf, underside × 2. 6. Plant, natural size. 7. Sepal × 10. 8. Androecium × 6. 9. Gynaecium × 6. (*Salter* 700.) *Del.* T. M. Salter.

anthesin deflexi, ad 3.5 cm. longi, ad medium vel in dimidio superiore 1- vel 2-bracteati bracteis linearibus alternantibus 1—1.5 mm. longis. *Sepala* lanceolata, 2.5—3 mm. longa, interdum apice nigrescentia, callis 2 parvis apicalibus nigris induta. *Corolla* ad 1.8 cm. longa, pallide violacea, breviter glanduloso-pubescens; tubus anguste infundibuliformis luteus, in dimidio superiore striis 5 angustis atro-violaceis notatus: petala e basi unguiculata obovato-spathulata, subtruncata, 4.5—6 mm. lata, venis violaceis notata, ad apicem marginemque exteriorem lutescens, inferne, supra sepala, anguste violaceo-marginata. *Filamenta* (parte connata inclusa) exteriora 3—5 mm. longa, glabra, interiora 4.5—7 mm. longa, glabra vel sparsissime glandulosa, edentata, antheris subsagittatis. *Ovarium* oblongum, 2.5 mm. longum, ad apicem pubescens, stylis inferne pubescentibus, superne minute glandulosis. *Capsula* elongata, moniliformis, fere 1 cm. longa, pubescens, striis 5 purpureis longitudinaliter ornata, loculis 3—4-ovulatis.

Var. β, **latituba,** Densius glandulosa. *Sepala* ovato-lanceolata. *Corolla* brevior, pallide lactea, tubo plus minusve *late infundibuliforme*: petala inferne subcuneata, vix unguiculata. *Ovarium* in dimidio superiore dense pubescens.

Hab. Cape Province: Van Rhyn's Dorp Dist; on south slopes of Van Rhyn's Pass, May 1931, *Salter* 700 (*type*) and between Van Rhyn's Dorp and Van Rhyn's Pass, 2500, 4479 and 4556; var. β., about Nieuwoudtville, 4475 (*type*), 1649 B (cult.). Both types are in the Bolus Herbarium.

This species is an affinity of *O. ebracteata*, Savign., but it is more branched and differs in having much narrower leaflets, bracteate peduncles and a long, often twisted subuliform bulb. It was growing plentifully in the *type* locality and so much resembled a pale violet species of Sutera (*S. aetheopica* O. Ktze.) which was plentiful in the same locality, as to be mistaken for it at first glance. Its appearance is evidently subject to favourable rains for although the locality (a particularly arid district) was searched in the two following seasons, not a single plant could be found.

Var. β, which grows at a higher altitude, is included under this species in spite of its very different corolla, for its bulb and general habit are very similar to that of the typical form.

Both forms have been studied in cultivation as well as in the wild state.

Oxalis levis, Salter (Oxalidaceae), § Tripartitae (Lineares).

Planta minuta ad 3 cm. alta, acaulis vel caule breviter exserto. *Bulbi* anguste ovoidei, apice acute attenuati, ad 2 cm. longi, plerumque congesti, tunicis nitentibus atro-brunneis. *Rhizoma* fere 6 cm. longum,

squamis paucis parvis deltoideis instructum, annorum praeteritorum rhizomatibus numerosis persistentibus obtectum. *Caulis* ad 4 mm. longus, glaber, squamis 1—2 ovatis amplexicaulibus instructus. *Folia* 2—5, basalia vel ad apicem caulis aggregata, petiolis filiformibus atro-brunneis, fere 1 cm. longis, glabris, ad basin articulatis : foliola 3, sessilia, linearia, conduplicativa vel rare involuta leviter emarginata, ad 9 mm. longa, vix 1 mm. lata, glabra, ecallosa, infra fusco-viridia, supra glauca. *Pedunculi* uniflori, 1—3, petioli aequantes, glabri vel superne sparsissime pubescentes, ad apicem bibracteati bracteis subulatis rubescentibus, 0.5—1 mm. longis. *Sepala* oblongo-lanceolata, subobtusa, 3—4 mm.

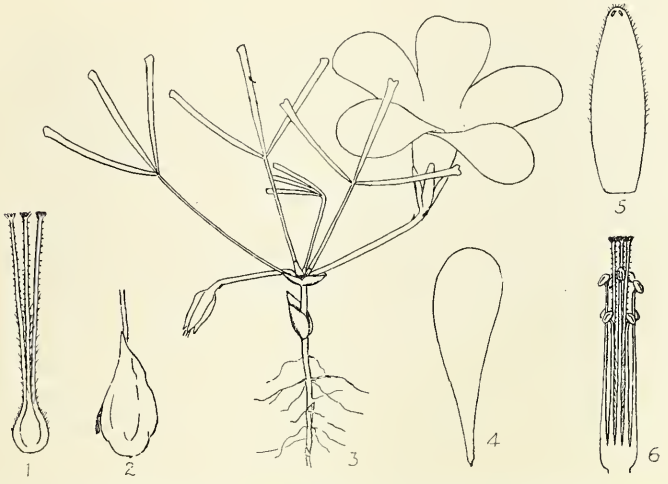

Fig. 5. *Oxalis levis* Salter. 1. Gynaecium × 6. 2. Bulb, natural size. 3. Plant × 2. 4. Petal × 2. 5. Sepal × 8. 6. Androecium, showing long styles × 6 (*Salter* 3358). *Del.* T. M. Salter.

longa, rare sparsissime pilosa, in parte superiore ciliata vel crispato-ciliata, callis 2 apicalibus inconspicuis ornata. *Corolla* 1.5—1.9 cm. longa, alba vel pallidissime violacea, tubo infundibuliforme, luteo : petala oblique lateque spathulata, ad basin vix vel leviter unguiculato-attenuata, margine anteriore rotundata, 5—6 mm. lata. *Filamenta* glabra, brevissime connata, interiora (parte connata inclusa) 4.5—5.5 mm. longa, edentata. *Ovarium* globoso-ovoideum, 1 mm. longum, in dimidio superiore pilosum, ecallosum, loculis 1—2-ovulatis, stylis inferne sparse pilosis, superne minutissime glandulosis. (Forma brevistylosa non visa.)

Hab. Cape Province : flats between Malmesbury and Mamre Road Station, 17 June 1933, *Salter* 3358 (*type* in Bolus Herbarium).

This species appears to be very local. It was growing with the bulbs, usually several together in a congested mass, embedded in heavy whitish clay, overlaid with a thin layer of sandy soil. Both in habit and general appearance it appears to be an affinity of *O. Mallyi*, Schltr., but it is a very much smaller plant with a white corolla and a broader and shorter tube. It also differs in its harder, blacker bulb tunics and 1—2-seeded capsule which does not elongate beyond the sepals in the fruiting stage. The numerous old dead rhizomes, surrounding the living one, were a noticeable feature.

Oxalis involuta, Salter. (Oxalidaceae), § Tripartitae (Lineares).

Planta parva gracilis, caule breviter exserto, partibus herbaceis omnino glabris. *Bulbus* minutus ovoideus, apice attenuatus vel subrostratus, fere 7 mm. longus, irregulariter angularis, tunicis tuberculatis brunneis. *Rhizoma* gracilis, squamis paucis instructum. *Caulis* 0.5—2.5 cm. longus, ad basin squamis, 1 vel 2, late ovatis, semiamplexicaulibus, ad 1 mm. longis, indutus. *Folia* 3—8, apice caulis aggregata, rarissime e squamis inferioribus exorientes, petiolis 3—8 mm. longis, exterioribus basi (infra articulum) squamoideo-dilatatis : foliola 3, anguste linearia, incurvo-adscendentia, marginibus plurimum involutis, itaque cylindrica, rarissime conduplicativa, emarginata, lobis minutis leviter divergentibus, ad 1 cm. longa, 0.2—0.3 mm. lata (complanata 0.6 mm. lata). *Pedunculi* uniflori, apice caulis aggregati, folia valde superantes, ad 5 cm. longi, 1—2 mm. infra apicem bibracteati bracteis alternantibus lineari-lanceolatis vel subulatis, 1—1.5 mm. longis. *Sepala* lanceolata, leviter attenuata, 3—4 mm. longa, rubescentia, apice callis 2 inconspicuis elongatis instructa. *Corolla* 1.5—2 cm. longa, laete flava, tubo late infundibuliforme concolore : petala cuneata, ad basin leviter unguiculato-attenuata, apice rotundata, 7—9 mm. lata, glabra. *Filamenta* (parte connata inclusa) 2.5—4 mm. longa, glabra, interiora 3.5—7 mm. longa, glanduloso-pubescentia, breviter dentata. *Ovarium* oblongum, 1.5—2 mm. longum, in dimidio superiore pubescens, loculis 3—4-ovulatis, stylis inferne pubescentibus, superne glandulosis.

Hab. Cape Province : Piquetberg Div. ; side of main road 8 miles south of Porterville, flowers May—July, *Salter* 3381 (*type* in Bolus Herbarium) 5409 ; loc? *Leipoldt*, Bol. Herb. 19747.

Allied to *O. goniorhiza*, Eck. and Zeyh., but distinguished from that species by its brilliant yellow flowers, much wider corolla tube, narrower

involute leaflets and much smaller and less sharply angular rough bulb. It was flowering abundantly in clayey gravel, but it appears to be very local.

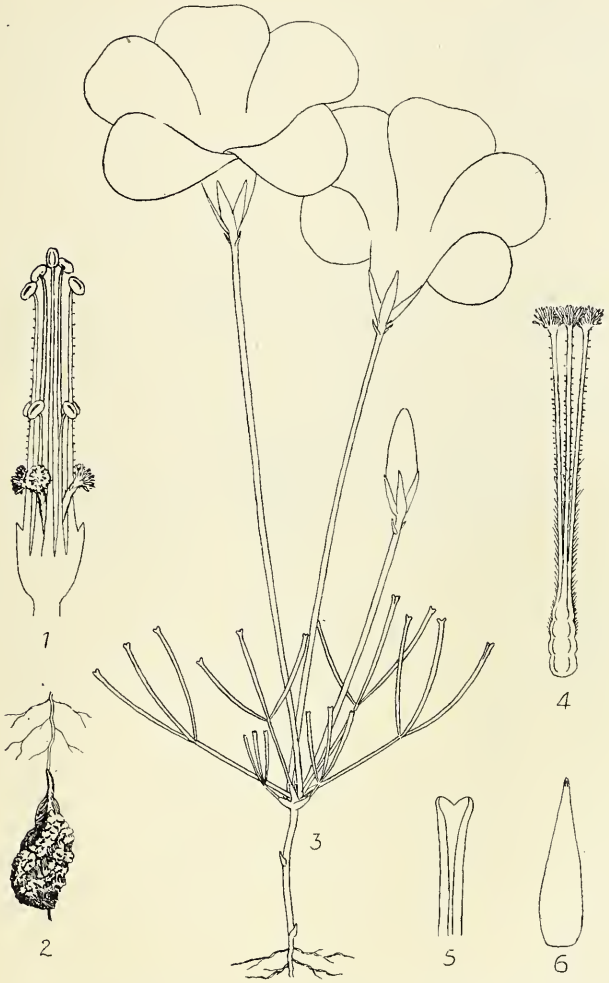

Fig. 6. *Oxalis involuta* Salter. 1. Androecium, showing short styles × 8. 2. Bulb × 3. 3. Plant × 2. 4. Gynaecium × 8. 5. Upper end of leaflet × 10. 6. Sepal × 6. (*Salter* 3381.) *Del.* T. M. Salter.

Oxalis strigosa, Salter. (Oxalidaceae), § Tripartitae (Obcordatae).

Planta robusta, caule non exserto. *Bulbus* tortuose subuloideus, longe rostratus, fere 8 cm. longus, ad basin 7—9 mm. latus, tunicis papyraceis, exterioribus, praecipue ad medium, transverse rugosis, undulatissimis, minute glanduloso-pilosis, pallide brunneis, interioribus laevigatis, nitentibus, apice rostro curvato atro-brunneo, ad 3 cm. longo. *Rhizoma* longissimum, ad 55 cm. longum (vel longius ?), glabrum, vel ad apicem extremum hirsutum, inferne squamis paucis glabris semi-amplexicaulibus, in parte superiore radiculis robustis, apice squamis obcordatis hirsutis inbricantibus obsitum. *Folia* basalia, ad 20 : petioli saepe 6 cm. longi, compressi, pilis erecto-patentibus dense hirsuti : foliola 3, breve petiolulata, late obcordata vel obdeltoideo-obcordata, antice sinu latissimo incisa vel truncata, 0.9—1.5 cm. longa, 1.2—2.1 cm. lata, utrinque concoloria, infra, praecipue in nervis, hirsuto-strigosa, supra et margine setis longis hyalinis nitentibus strigosa punctisque minutis numerosissimis induta. *Pedunculi* uniflori, pauci, petiolis graciliores, 3—7 cm. longi, post anthesin in parte superiore deflexi, adpresse pilosi, paulo supra medium bibracteati : bracteae lineares alternantes, pilosae, rubro-callosae, fere 2 mm. longae. *Sepala* ovato-oblonga, 5—6 mm. longa, hirsuta, margine conspicue atro-purpurea, in dimidio superiore callis nonnullis elongatis rubris ornata. *Corolla* ad 2.5 cm. longa, glabra, supra laete rosea, infra pallidior, tubo infundibuliformè obscure luteo, purpureo-nervato (in sicco pallide violacea, concoloria) : petala, e basi unguiculata, cuneata, oblique subtruncata, saepe leviter retusa, ad 1 cm. lata, infra anguste rubro-marginata. *Filamenta* (parte connata inclusa), exteriora 2.5—5 mm. longa, glabra, interiora 5—6.5 mm. longa, externe breve glanduloso-pilosa, dentibus latis obtusis instructa. *Ovarium* ovato-oblongum, inferne sparse glandulosum, superne hirsutum, ad apicem callis nonnullis rubris notatum, loculis 2-ovulatis : styli hirsuti : stigmata parva viridia. *Capsula* globosa, dense hirsuta.

Hab. Cape Province : Tygerberg Range on southern slopes, 900-1100 ft., flowers Apl.-May, *Salter* 557 (*type* in Bolus Herb.) and *Pillans* 4751 ; south slope of Kanon Berg, *Salter* 522.

This species appears to be confined to the Tygerberg Range near Cape Town, where it is fairly plentiful locally, always at about the same altitude, but I have been unable to find it on any of the neighbouring hills. It was first collected by Mr. N. S. Pillans in Aug. 1924, without flowers.

The long, irregularly twisted bulbs have peculiar crinkled tunic-scales, furnished with minute capitate hairs, and end at the apex in a slender pointed beak roughly an inch long. As in some other species

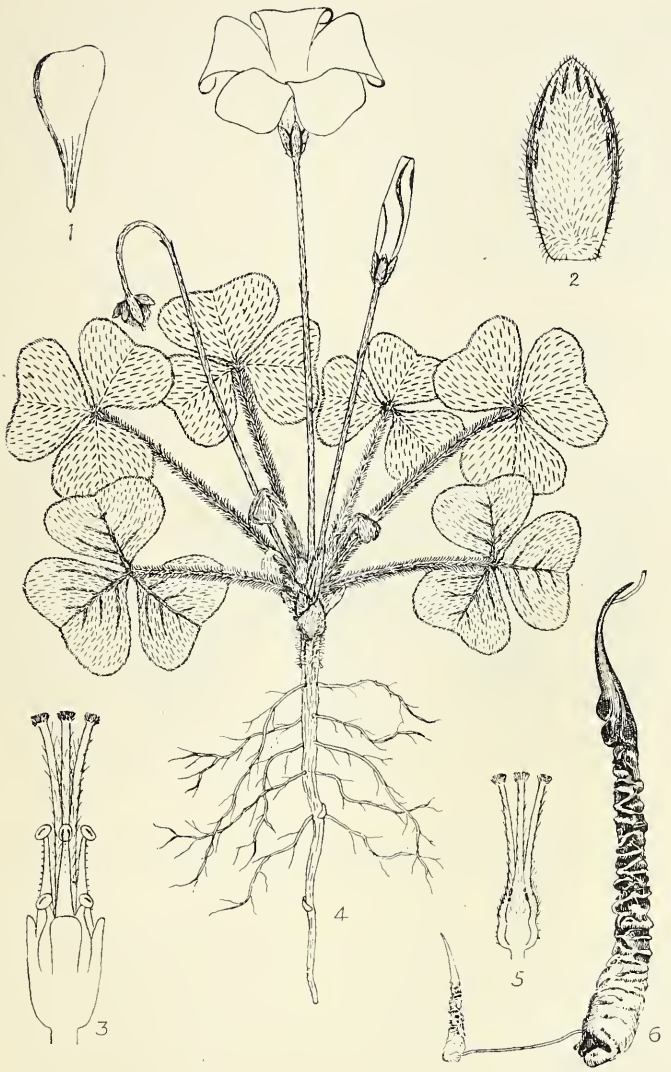

FIG. 7. *Oxalis strigosa* Salter. 1. Petal, natural size. 2. Sepal × 6. 3. Androecium showing long styles × 6. 4. Plant, natural size. 5. Gynaecium with medium styles × 6. 6. Bulb, natural size. (*Salter* 557.) *Del.* T. M. Salter.

new bulbs are formed each year on vertical or lateral underground runners produced from near the base of the old bulb and they often attain a great depth, one having been obtained with a rhizome roughly 2 ft. long.

It is an affinity of *O. truncatula*, Jacq., which it resembles superficially and, like that species, often produces flowers before the leaves appear, but in addition to the great difference in the bulb, it has a glabrous rhizome, concolorous leaflets with thick hyaline setaceous adpressed hairs on the upper surface and not silky below, alternate bracts, not set at an articulation in the peduncle, and a glabrous corolla.

Oxalis lasiorhiza, Salter. (Oxalidaceae), § Tripartitae (Obcordatae). *Planta* hirsuta, caule non exserto, ad 4 cm. alta. *Bulbus* ovoideus,

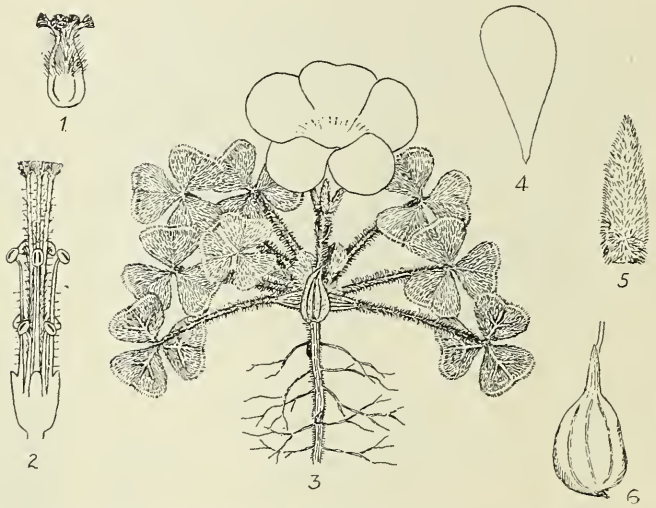

Fig. 8. *Oxalis lasiorhiza* Salter. 1. Gynaecium × 6. 2. Androecium showing long styles × 6. 3. Plant, natural size. 4. Petal. natural size. 5. Sepal × 4. 6. Bulb, natural size. (*Salter* 4555.) *Del.* T. M. Salter.

apice longe rostratus, 2 cm. longus, tunicis pallide brunneis, nervis pallidioribus prominentibus longitudinaliter venatis. *Rhizoma* fere 30 cm. longum, vel longius, 1.5 mm. latum, costato-striatum, patenter pubescens, squamis ovatis vel anguste ovatis semiamplexicaulibus pubescentibus brunneis indutum. *Folia* ad 30, basalia : petioli ad 2.5 cm. longi dense villoso-hirsuti, exteriores ad basin, etiam ad medium, articulati, inferne (infra articulum) squamoidei, anguste deltoidei, subpellucidi, ciliati, 3-nervati, superne teretes : foliola 3, breve petiolulata, crassa, late

cuneato-obcordata vel obdeltoideo-obcordata, fere 0.8 cm. longa, 1 cm. lata, supra strigoso-sericea, infra dense sericea, nervo mediale conspicuo, dense ciliata, concoloria. *Pedunculi* uniflori, e foliorum rosula provenientes, 1—2 cm. longi, densissime cano-hirsuti, supra medium in articulo superiore bibracteati bracteis oppositis linearibus pilosis, 1—3 mm. longis. *Sepala* lato-lanceolata, 5—6 mm. longa, dense villoso-hirsuta, ecallosa. *Filamenta* (parte connata inclusa), exteriora 3—4.5mm. longa, glabra, interiora 4.5—7.5 mm. longa, sparse pluricellulari-pilosa, dentibus subobtusis, 0.2 mm. longis, instructa. *Ovarium* ovoideo-oblongum, 2 mm. longum, ad basin glabrum, superne dense cano-pilosum, loculis 2—3-ovulatis : styli pilis simplicibus pluricellularibusque admixtis pilosi.

Hab. : Cape Province : Calvinia Div. ; 8 miles north-west of Nieuwoudtville, amongst bushes, June 1934, *Salter* 4555 (*type* in Bolus Herbarium).

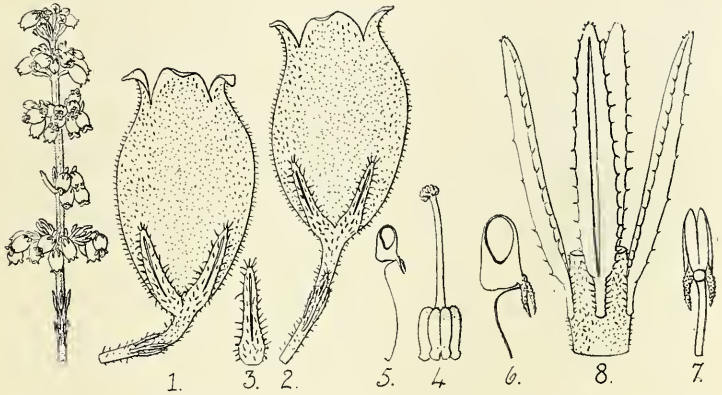

Fig. 9. *Erica Bolusiae* Salter. (Natural size.) 1. and 2. Flower × 9. 3. Sepal × 9. 4. Gynaecium × 9. 5. Stamen, side view × 9. 6. Anther, side view × 18. 7. Anther, back view × 18. 8. Whorl of leaves × 9. (*Salter* 5241.) *Del.* W. F. Barker.

An affinity of *O. truncatula*, Jacq., differing in its short peduncles, bright sulphur-yellow corolla, concolorous leaves, ecallous sepals, paler brown bulb and in the pluricellular indument on the filaments and styles.

Erica Bolusiae, Salter. (Ericaceae-Ericoideae.) § Ephebus.

Frutex suberectus, 30—50 cm. altus. *Caulis* erectus vel interdum subflexuosus, glaber. *Rami* adscendentes, praecipue in parte superiore pubescentes. *Folia* 4-nata, adscendentia, linearia, obtusiuscula, leviter

incurva, cum internodis aequantia vel breviora, juniora imbricantia (petiolo incluso) ad 5 mm. longa, sparse breviterque pubescentia, ciliata, infra sulcata, petiolis ciliatis fere 0.6 mm. longis. *Flores* 4-nati ramulos breves terminantes, dispersi vel ad ramorum apices cumulati et pseudo-racemosi. *Pedunculi* 1.5—2.2 mm. longi, leviter curvati, pubescentes, saepe rubescentes, bracteis 3, parvis, ciliatis, ad medium vel infra medium positis. *Sepala* 1.5—1.8 mm. longa, pubescentia, ciliata, e basi ovata vel orbiculare scariosa attenuata, in parte superiore ($\frac{1}{3}$—$\frac{2}{3}$) foliosa, sulcata. *Corolla* globoso-urceolata vel ovoideo-urceolata, rarius anguste ovoideo-urceolata, supra medium leviter ventricosa, 3—4.5 mm. longa, patenter pubescens, alba, segmentis obtusis, fere 0.7 mm. longis, interdum pallide roseis. *Stamina* inclusa, filamentis superne sigmoideis, antheris dorsifixis aristatis lato-oblongis vel cuneato-oblongis, 0.6 mm. longis, dorsaliter minutissime ciliatis, poro dimidio lobi vel paulo longiore : aristae deflexae subulatae, minute serratulatae, minutissime ciliatae, 0.4—0.5 mm. longae. *Ovarium* cylindricum, in adumbratione subquadratum, in dimidio superiore pubescens, stylo incluso, stigmate capitato.

Hab. : Cape Province : Bellville District ; 3 miles east of Kraaifontein in sand, 12 Apr. 1935, *Salter* 5241 (*type* in Bol. Herb.) ; *L. Bolus* in Bol. Herb. 19516.

This species superficially resembles *E. subdivaricata*, Berg, but must be placed in § Ephebus on account of its pubescent corolla. It is perhaps nearest to *E. hirtiflora*, Curt., but differs in its smaller size, less dense habit, the short sparse pubescence on the leaves, slightly ventricose white corolla with shortish not hispid hairs, different shaped anthers with shorter and narrower awns and pubescent ovary.

Euphorbia juglans R. H. Compton (Euphorbiaceae-Euphorbieae).

Planta dioica, pumila, succulenta, espinosa, corpore principe et ramorum parte majora subterraneis. *Caulis* princeps subcylindricus, diam. 2—3 cm., in radicem principem, radiculis paucis angustis superficialibus instructam, angustans. *Rami* 1—5, long. 3—5 cm., diam. 1.5—2.5 cm., in summo caulis erecti, parte exposita subhemispherica, griseo-viride vel brunneo-tincta, infra solum in collum diam. 3 mm. ad insertione angustante, angulis 6—9 haud carinatis, cicatricibus parvis impressis pedunculorum defluentium inter se 2—3 mm. notatis, striis acutis profundis 2 mm., inferne minime profundis, apice leviter depresso. *Folia* non visa. *Inflorescentia* uno cyathio, vel etiam rarius cyathiis 1 vel 2 lateralibus. Masculi : *pedunculi* long. 4—6 mm., puberuli, laete virentes, rubro-brunneo-tincti ; *bracteae* long. 1—2 mm., ad basin pedunculi 2, ad summum 3, puberulae ; *involucrum* obconicum, long. 3 mm., diam. 3 mm., glandis 5 contiguis, late obtusis, externe rubro-brunneis,

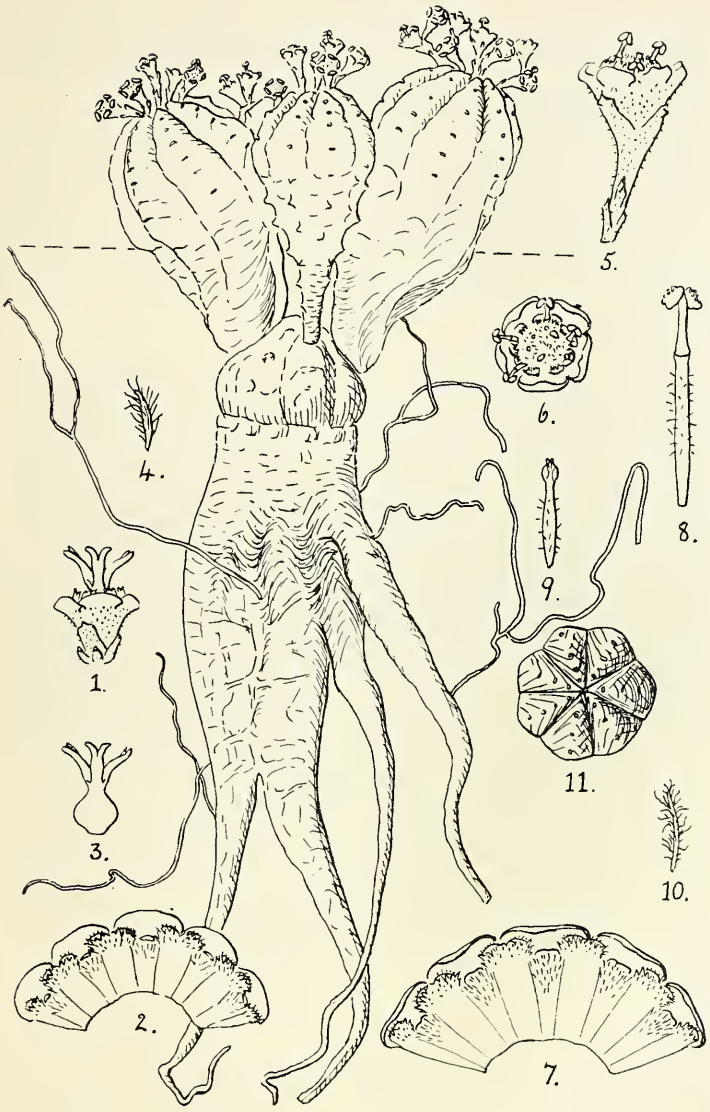

Fig. 10. *Euphorbia juglans* R. H. Compton. (Male plant, natural size showing ground level.) 1. Female inflorescence × 4. 2. Female involucre from above × 8. 3. Female flower × 4. 4. Bract from female inflorescence × 8. 5. Male inflorescence × 4. 6. Male inflorescence, from above × 4. 7. Male involucre from above × 8. 8. Male flower × 8. 9. Sterile flower from male inflorescence × 8. 10. Bract from male inflorescence × 8. 11. Branch, apical view. (*Compton* 3951.) *Del.* W. F. Barker.

interne laete virentibus, squamis 5 subquadratis, obtuse fimbriatis, utrinque puberulis, rubro-tinctis. Feminei: similes sed minores; *pedunculi* long. 2—3 mm., *cyathio* long. et diam. 1.5—2.0 mm., *stylis* basi conjunctis, apice bilobatis, laete virentibus.

Hab.: Cape Province: Ladismith Division: about 20 miles west of Ladismith in stiff clay soil strewn with broken white quartz fragments, *Compton* 3951. (*Type* in Bolus Herbarium and in cultivation at the Karoo Garden, Whitehill.) Also *Compton* in National Botanic Gardens, Kirstenbosch, 222/32, in Bolus Herbarium. *W. F. Barker* and *G. J. Lewis* in Bolus Herbarium, 20347. *Bolus* in National Botanic Gardens 711/32, and *Davis* in National Botanic Gardens 2462/32, both from Little Karoo.

This is a very inconspicuous Euphorbia, only the terminal portions of the stems appearing above ground as one or a few hemispherical domes. These have suggested to collectors a vague resemblance to half walnut shells, hence the specific name. The growth is slow and the stems seem to be pulled down into the soil by the longitudinal contraction of the subterranean parts. (In cultivation, however, especially if planted among stones, the contraction may not take place and the stems protrude for some distance above the surface.) The plant is usually found in the white quartz-strewn patches occurring in the Bokkeveld beds of the Little Karoo, in association with *Crassula columnaris*, *Anacampseros papyracea*, *Gibbaeum pubescens*, *Rimaria spp.*, etc., but it is not strictly confined to these peculiar habitats. It has been grown for several years in the Karoo Garden, Whitehill, and has not appreciably changed its characters. It flowers at the end of the summer (April—May).

Euphorbia juglans appears to be most closely related to *E. pyriformis* N. E. Br. This latter species was described from a single (male) specimen from an unknown locality, cultivated in England: a plant collected by Mr. J. Archer near Uitenhage and grown at Whitehill (Archer 245) is probably *E. pyriformis*. (Specimen in the Bolus Herbarium.) In many respects *E. juglans* resembles this plant, but differs in the much less prominent ridges and furrows of its stem, as well as in its smaller size, its more subterranean habit and in small floral details.

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PLANTAE NOVAE AFRICANAE.

"Ex Africa semper aliquid novi."—*Pliny.*

SERIES IV.

By

T. M. Salter and R. H. Compton.

With Text Figures drawn by T. M. Salter and Miss W. F. Barker.

Oxalis aridicola, Salter (Oxalidaceae), § Tripartitae (Glandulosae). *Planta* gracilis ad 13 cm. alta, caule satis exserto, partibus herbaceis pubescentibus cum pilis longioribus capitatis admixtis. *Bulbus* ovoideus, apice acutus fere 2 cm. longus, tunicis rigidis atro-brunneis. *Rhizoma* saepe 6—8 cm. longum, squamis parvis subamplexicaulibus instructum. *Caulis* 4—7 cm. longus, rare ramosus, squamis parvis 1—3 indutus. *Folia* ad 18, caulis apice aggregata, rarissime 1—2 caulina: petioli graciles, 0·5—2 cm. longi, ad basin articulati: foliola 3, petiolulata, anguste cuneato-obovata, leviter incisa, interdum conduplicativo-falcata, plerumque 8 mm. longa, 4 mm. lata, supra glabra vel utrinque pubescentia, ciliata, ad marginem anteriorem callis parvis brunneis inconspicuis saepe punctata. *Pedunculi* uniflori, 1—3·5 cm. longi, quam petioli 2-plo latiores, ad basin articulati, in dimidio superiore bibracteati bracteis alternantibus filiformibus, 1·5—2·5 mm. longis, rubro-brunneis. *Sepala* lanceolata vel late lanceolata, attenuata, 3—4 mm. longa, ciliata, apice callis 2 elongatis rubescentibus instructa. *Corolla* 1·5—2·5 cm. longa pallide violacea, tubo angustissime infundibuliforme vel subcylindrico, glanduloso-piloso, luteo, quam laminae paulo longiore: petala spathulata, 3—4 mm. lata, infra ad marginem exteriorem glanduloso-pilosa. *Filamenta* (parte connata inclusa) exteriora 6—9·5 mm. longa, glabra, interiora 8·5—13 mm. longa, inaequalia, glabra vel minute glandulosa, edentata. *Ovarium* oblongum, 1—2 mm. longum, in dimidio superiore pubescens, ad apicem callis elongatis instructum, loculis 2—3-ovulatis, stylis inferne pubescentibus, superne glandulosis.

Hab. Cape Province: Clanwilliam Div.; about Langekraal, flowers May—July. *Salter* 2467 (*type* in Bolus Herbarium), 4440, 4547, *Leipoldt*, Bol. Herb. 19692; Calvinia Div.; near Doornbosch, *Salter* 5379.

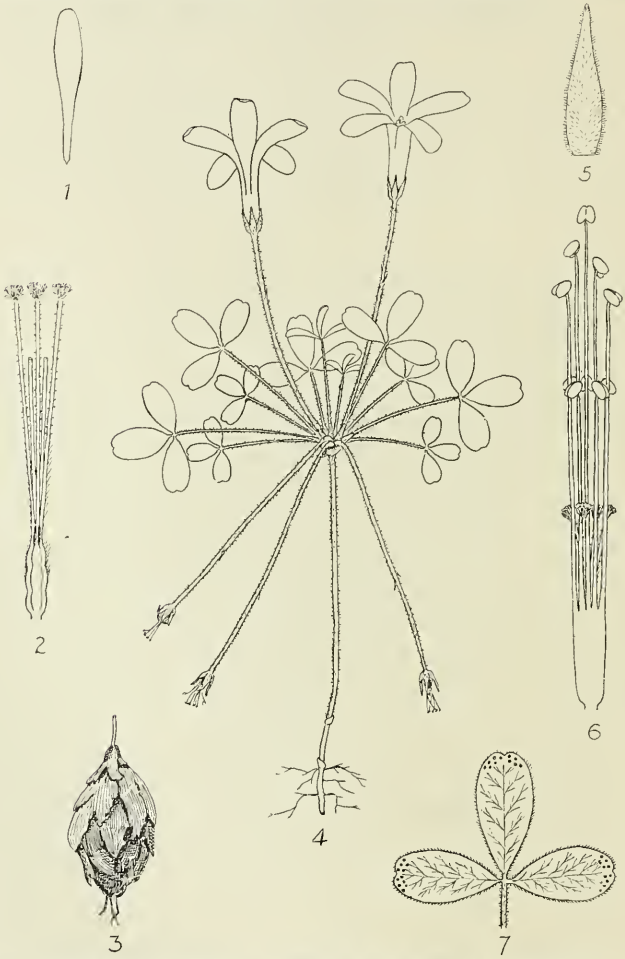


Fig. 1. *Oxalis aridicola* Salter. 1. Petal, natural size. 2. Gynaecium × 6. 3. Bulb, natural size. 4. Plant, natural size. 5. Sepal × 6. 6. Androecium × 6. 7. Leaf, under side × 2. (*Salter* 2467.) *Del.* T. M. Salter.

An affinity of *O. tenella*, Jacq., from which it differs in having a proportionally longer and much narrower corolla tube, narrower petals,

longer filaments and styles, the latter with gland-tipped, not pluricellular hairs and glandular hairs on all the herbaceous parts except the leaflets.

It grows in an arid district and in most seasons is only to be found n a dwarf and starved condition. No. 2467, found in an unusually wet season has been taken as the type and plants grown from bulbs of No. 4440 in cultivation resemble this closely.

Oxalis campicola, Salter (Oxalidaceae), § Tripartitae (Lineares).

Planta parva gracilis, caule exserto, 4—7 cm. alta. *Bulbus* ovoideus vel globoso-ovoideus, breve attenuatus, ad 1·5 cm. longus, tunicis papyraceis brunneis. *Rhizoma* 2—4 cm. longum, squamis parvis instructum. *Caulis* erectus gracilis rigidus, 1·5—4 cm. longus, simplex vel rare ramosus, glaber vel minutissime pubescens, atro-viridis, squamis 1 vel 2 amplexicaulibus ciliatis indutus. *Folia* 6—16, ad apicem caulis aggregata, petiolis filiformibus ad 2·0 cm. longis, sparse pubescentibus : foliola 3, sessilia, linearia, conduplicativa vel involuta, plus minusve falcata, minute emarginata, circa 1 cm. longa, 2 mm. lata, supra glabra, infra sparse pubescens, interdum inconspicue minuteque nigro-punctata, apice callis 2 rubris (in sicco atris) notata. *Pedunculi* satis numerosi, uniflori, apicales vel rare e squamis inferioribus exorientes, graciles, ad 2 cm. longi, glabri vel sparse pubescentes, apice vel paulo infra calycem bibracteati bracteis subulatis alternantibus pubescentibus fere 1·5 mm. longis. *Sepala* lanceolata vel ovato-lanceolata, 3—4·5 mm. longa, sparse pubescentia, ciliata, margine anguste membranacea, ad marginem, basin versus, atro-purpurea, superne aurantiaco-callosa, ad apicem callis 2 oblanceolatis aurantiacis ornata. *Corolla* 1·4—2 cm. longa, alba, tubo infundibuliforme luteo : petala e basi unguiculata superne oblique obovata, leviter truncata, 4—5 mm. lata, margine exteriore inferiore saepe anguste purpureo-maculata. *Filamenta* (parte connata inclusa) exteriora 2·5—4 mm., glabra, interiora 4·5—6 mm. longa, sparse glanduloso-pilosa, edentata. *Ovarium* oblongum, ad 1·3 mm. longum, superne callis elongatis notatum, in dimidio superiore cano-pubescens, stylis saepe purpureis, inferne pubescentibus, superne pluricellulari-pilosis. *Capsula* globosa vel oblonga, loculis 2 vel 5—6-ovulatis.

Hab. Cape Province : Calvinia Div. : Karamoe, flowers May-July, *Salter* 4445 (*type* in Bolus Herbarium) 1650 B (cult), 2480, 5375 ; 2 miles north of Van Rhyn's Dorp *Salter* 716, *Pillans* 6636.

An affinity of *O. Mundtii*, Sonder, but more slender and wiry. It also differs in having narrower leaflets, a white purple-edged corolla and pluricelled hairs on the upper half of the styles.

There appear to be two forms, one with 2 ovules in each ovary-cell and one with 5—6 ovules. That with 2 ovules (*Salter* 716) has a globose

capsule, and usually rather larger anthers and stigmas and yellowish green styles, while that with 5—6 ovules, with a more elongate capsule, generally has purple styles. These characters, however, are not invariably constant and I have found both forms growing together at Karamoe (*Salter* 2480). The plants look exactly alike, the minute differences not

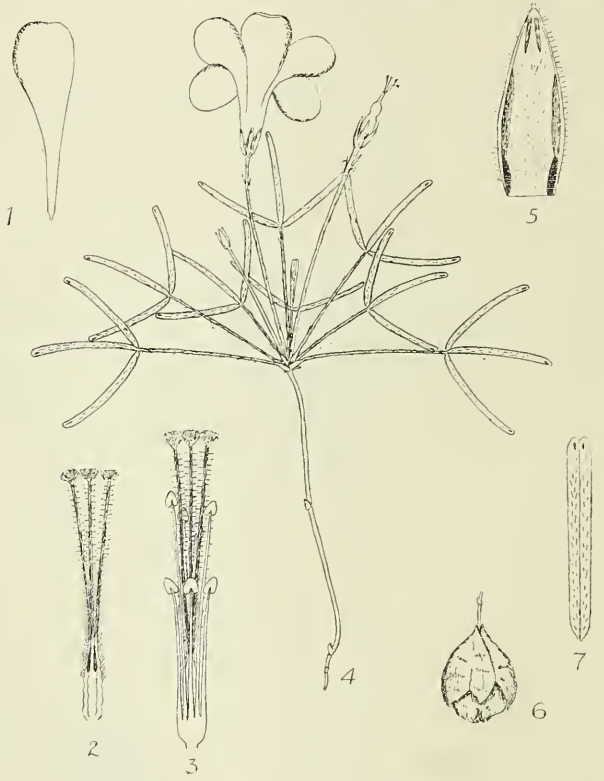


Fig. 2. *Oxalis campicola* Salter. 1. Petal × 2. 2. Gynaecium × 8. 3. Androecium × 8. 4. Plant × 1½. 5. Sepal × 8. 6. Bulb, natural size. 7. Leaflet, under side × 3. (*Salter* 4445.) *Del.* T. M. Salter.

being distinguishable with the naked eye and I therefore hesitate to make any varietal distinction.

Oxalis flaviuscula, Salter (Oxalidaceae), § Multifoliolatae.

Planta parva ad 3·5 cm. alta, caule non exserto. *Bulbus* late subuloideus, saepe tortuosus, breviter acutissimeque rostratus, tunicis

papyraceis undulatis brumneis. *Rhizoma* 32 cm. longum (vel longius ?), inferne gracillimum, cortice papyraceo brunneo laxe obtectum, superne squamis ovatis amplexicaulibus acutis glabris, ad 4 mm. longis indutum. *Partes herbaceae* plus minusve patenter puberulae, rare glabrescentes

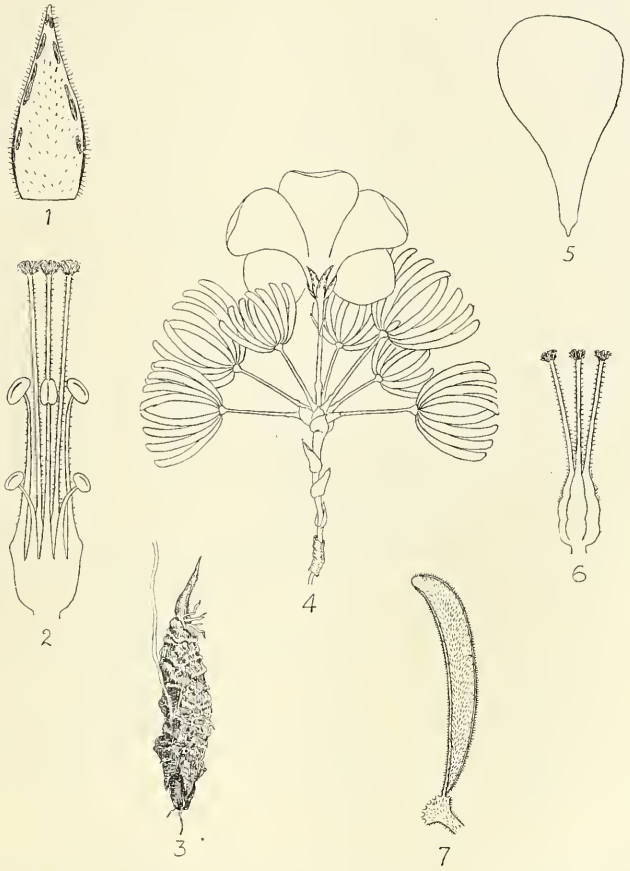


Fig. 3. *Oxalis flaviuscula* Salter. 1. Sepal × 6. 2. Androecium × 6. 3. Bulb, natural size. 4. Plant, natural size. 5. Petal × 1½. 6. Gynaecium × 6. 7. Leaflet folded, under side × 3. (*Salter* 5524.) *Del.* T. M. Salter.

vel glabrae. *Folia* basalia, 5—27 : petioli 0·5—2 cm. longi, saepe leviter compressi, virides, ad basin manifeste articulati, apice abrupte dilati : foliola 5—9, breviter petiolulata, cum petioli pulvino articulati, lineari-

oblonga, interdum levissime cuneata, conduplicativo-falcata, obtusa, 0·7—1·6 cm. longa, 2—3 mm. lata, nervo mediale conspicuo, margine anguste subcartilagineo, supra glabra, ciliata, plerumque, praecipue ad apicem, inconspicue brunneo-punctata. *Pedunculi* uniflori, 0·5—1·5 cm. longi, in parte inferiore manifeste articulati, paulo infra calycem bibracteati bracteis linearibus alternantibus aurantiaco-callosis, ad 3 mm. longis. *Sepala* ovato-lanceolata, acuta, plerumque attenuata, ciliata, ad margines callis elongatis aurantiacis conspicue ornata, interdum in dimidio inferiore anguste purpureo-marginata. *Corolla* 1·2—2·2 cm. longa, flava, tubo breve late infundibuliforme concolore : petala e basi breviter unguiculata late cuneato-obovata, antice oblique subtruncata, 0·7—1·2 cm. lata. *Filamenta* (parte connata inclusa) exteriora 2·5—5 mm. longa, glabra, interiora 5—9 mm. longa, sparse minuteque glanduloso-pilosa, leviter gibbosa. *Ovarium* ovoideo-oblongum, 1·5—2 mm. longum, glabrum vel superne, sicut styli, breviter pluricellulari-pilosum. *Capsula* subglobosa, loculis 2—3-ovulatis.

Var. *β*. **longifolia.** *Petioli* teretes, rubro-brunnei. *Foliola* 5—7, 1·3—3·8 cm. longa, angustiora. *Corolla* pallide lutea : petala ad margines exteriores striis punctisque parvis purpureis plerumque maculata.

Hab. Namaqualand : Springbok, in hard sandy gravel on golf links, flowers June, *Salter* 5524 (*type*), 896, 4678 ; var. *β* nine miles north of Kamieskroon, *Salter* 2563 (*type*), 4576. 5566. Steinkopf, *M. Schlechter* 72. Both types are in the Bolus Herbarium.

An affinity of *O. flava*, Jacq. but a more compact plant, smaller in all respects. It also differs in being clothed with short patent puberulous hairs, in its acute sepals, short corolla tube, slightly gibbose, not dentate, inner filaments and elongate bulb. Var. *β* differs very much in general appearance and might perhaps be regarded as a separate species. The corolla is pale yellow, the petioles are brown and the leaflets fewer, much longer and narrower.

I have had both forms in cultivation for three years, but neither has produced flowers. With the exception of a tendency to elongation of the petioles under the less arid conditions of the Cape Peninsula, each has retained its characteristic foliage.

Oxalis fragilis, Salter (Oxalidaceae), § Tripartitae (Lineares). *Planta* tenuis, caule exserto, ad 10 cm. alta. *Bulbus* parvus, inferne paulo attenuatus, superne attenuato-acutus, ad 9 mm. longus, 5 mm. latus, tunicis apiculatis laevigatis atrobrunneis leviter nervatis. *Rhizoma* 2—4 cm. longum, squamis parvis amplexicaulibus indutum. *Caulis* 2—3 cm. longus, simplex vel rare bifurcatus, ad basin pubescens, superne glaber vel sparsissime pilosus, squamis 1—2 amplexicaulibus

ciliatis instructus. *Folia* 7—12, petiolata, ad apicem caulis conferta, interdum 1—2 caulina : petioli caulini, ovato-lanceolati, squamiformes, ciliati, superiores 0·5—1·0 cm. longi, pubescentes, exteriores ad basin

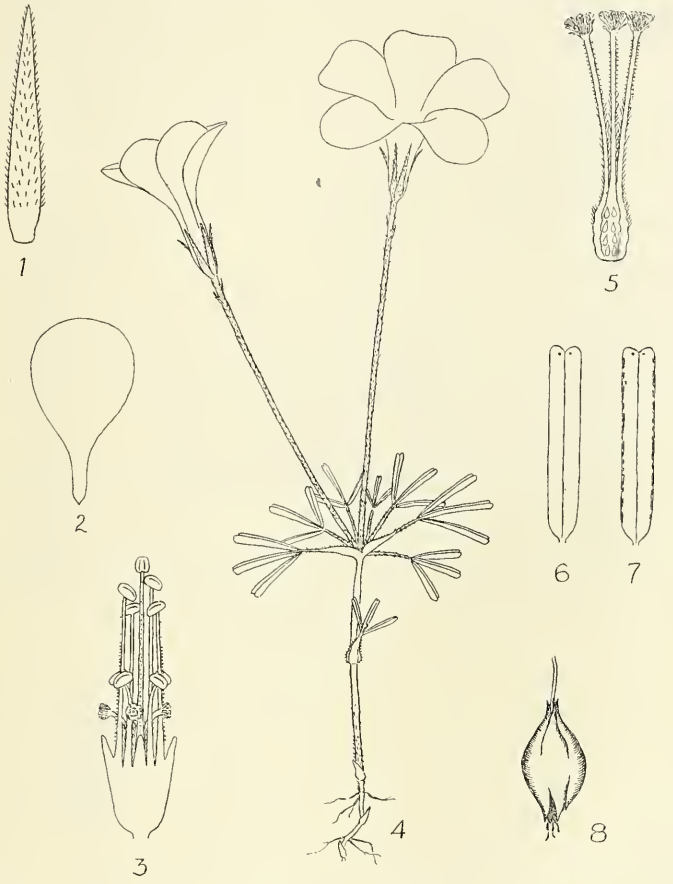


Fig. 4. *Oxalis fragilis* Salter. 1. Sepal × 6. 2. Petal × 1½. 3. Androecium × 8. 4. Plant × 1½. 5. Gynaecium × 8. 6. Medial leaflet (open) × 5. 7. Leaflet of var. β × 5. 8. Bulb × 2. (*Salter* 660.) *Del.* T. M. Salter.

dilati, ciliati : foliola 3, subsessilia linearia conduplicativa, saepe leviter falcata, emarginata, 5—8 mm. longa, 1·0—1·5 mm. lata, glabra, ecallosa vel apice callis 2 minutis instructa. *Pedunculi* 1—2 apicales, uniflori,

2—4 cm. longi, pubescentes, paulo infra calycem bibracteati bracteis alternantibus rubro-callosis, 1·5—2 mm. longis. *Sepala* anguste lineari-lanceolata, acutissima, 6—7 mm. longa, sparse pubescentia, ciliata, ecallosa. *Corolla* 1·8—2 cm. longa, pallide straminea, tubo infundibuliforme luteo: petala e basi breviter unguiculata superne obovata, interdum leviter truncata. *Filamenta* (parte connata inclusa) exteriora 1·5—3 mm., glabra, interiora 3—5·5 mm. longa, externe glanduloso-pilosa, dentibus acutis circa 0·5 mm. longis. *Ovarium* oblongum, 1·3 mm. longum, in dimidio superiore pilosum, ecallosum, loculis 8-ovulatis, stylis inferne pilosis, superne glabris vel glanduloso-pilosis.

Var. β. **pellucida.** *Foliola* punctis elongatis (in vita) pellucidis (in sicco) atris marginaliter notata. *Corolla* roseo-aurantiaca, tubo luteo.

Hab. Cape Province: Piquetberg Div.; by roadside 7 miles north of Moorreesburg, flowers May—July, *Salter* 660 (*type*) 383/3A, 2418, 3427B, 5425, *Pillans* 6647: var. β., *Salter* 2437, 3427, 5426 (*type*). Both types are in the Bolus Herbarium.

An affinity of *O. glabra*, Thunb. and *O. leptocalyx*, Sond, which is, in my opinion, merely one of the many forms of *O. glabra*. It differs in having straw-coloured petals with the claw about half the length of the lamina instead of equal to it.

Var. β has a reddish-orange corolla, and pellucid dots on or near the margins of the leaflets and in some specimens the claw of the petal is a little longer than in the typical form.

Both of these plants seem to be confined to a very limited area. There is a distinct line of demarcation between the typical form and the variety and although I have suspected hybridisation with *O. glabra* in the case of var. β, I have failed to find that species in the vicinity.

Oxalis oculata, Salter (Oxalidaceae), § Tripartitae (Rotundatae).

Planta parva, 2—9 cm. alta, acaulis vel caule breviter exserto. *Bulbus* ovoideus vel anguste ovoideus, apice acutus, 1·5—2·5 cm. longus, tunicis tenuibus imbricantibus, minute depresso-punctatis, brunneis. *Rhizoma* ad 10 cm. longum, squamis parvis amplexicaulibus et radiculis filiformibus pilosis indutum, stolonibus subterraneis lateralibus squamiferis et bulbiferis instructum. *Caulis* nil vel ad 1·5 cm. longus, dense breveque crispato-pubescens. *Folia* 7—20, petiolata, basalia vel ad caulis apicem conferta: petioli ad 2 cm. longi, patenter cano-pubescentes, exteriores saepe squamiformes vel ad basin dilati: foliola 3, breviter petiolulata, ovalia vel elliptica vel cuneato-elliptica, conduplicativo-falcata emarginata, 6—8 mm. longa, complanata 4—6 mm. lata, supra glabra, infra adpresse pubescentia, ciliata. *Pedunculi* uniflori, 1—3 cm. longi, folia paulo superantes, cano-pubescentes, in parte

superiore bibracteati bracteis subulatis pubescentibus callosis, 1·5—2 mm. longis. *Sepala* lanceolata, obtusa, 4—5 mm. longa, pubescentia, ciliata, ad apicem marginesque callis oblongis aurantiacis induta, inter-

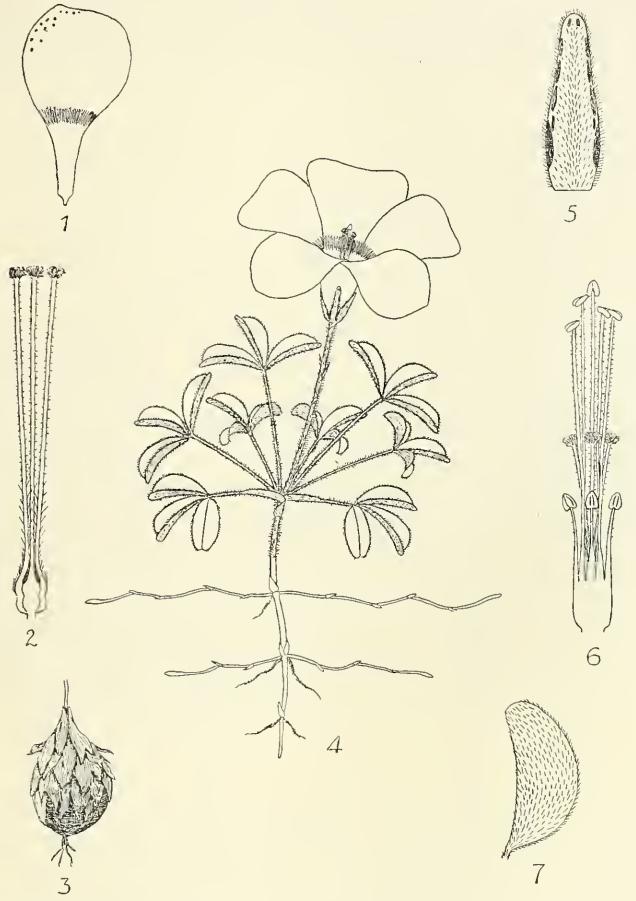


Fig. 5. *Oxalis oculata* Salter. 1. Petal × 1½. 2. Gynaecium × 5. 3. Bulb, natural size. 4. Plant × 1½. 5. Sepal × 6. 6. Androecium × 5. 7. Under side of leaflet folded × 3. (*Salter* 5363.) *Del.* T. M. Salter.

dum margine inferiore purpurascentia. *Corolla* 1·7—2·1 cm. longa, in vita rosea-rubra (in sicco lilacea), tubo infundibuliforme, quam lamina breviore, luteo, in faucibus purpureo-annulata : petala e basi unguiculata,

obovata, 9—10 mm. lata, apice truncata, ad marginem exteriorem pubescentia et callis parvis aurantiacis plus minusve ornata. *Filamenta* e corollae tubo exserta (parte connata inclusa) exteriora 3·5—7 mm. interiora 7—10 mm. longa, minute glandulosa, edentata. *Ovarium* ovoideum, ad 1·5 mm. longum, superne pubescens, inter angulos callis elongatis miniatis (in sicco) atris indutum, loculis 1—2-ovulatis, stylis ad basin pubescentibus, superne breviter pluricellulari-pilosis, stigmatibus parvis.

Var. β, **minor**. *Flores* multo minores, rubri. *Rhizomata* sine stolonibus subterraneis.

Hab. Cape Province : Calvinia Div. ; 7 miles east of Nieuwoudtville, flowers May—June, *Salter* 5363 (*type*), about Nieuwoudtville 1649A (cult.), 4472, 4459, 4471, Oorlog's Kloof River, 4447, 5373 ; var. β, between Karamoe and Nieuwoudtville, *Salter* 2482, Oorlog's Kloof River 5372 (*type*). Both types are in the Bolus Herbarium.

An affinity of *O. petiolulata*, Bolus f., but not entirely glabrous like that species. It also differs in having bibracteate peduncles, sepals with marginal calli, pubescent callous-dotted petals, shorter petiolules and in the absence of black calli on the leaflets.

The two forms taken as the type and variety were seen growing in association and the difference in habit of var. β was most marked. In addition to having much smaller and darker flowers the plants grow in small congested clusters, indicating that the new bulbillae are produced in the axils of the rhizome scales. In the typical form the plants were all a little distance apart owing to the new bulbs forming at the ends of the lateral underground runners which may be seen in the specimens. The styles and stamens vary somewhat in length but the longer organs are always exserted beyond the mouth of the corolla tube. The dark purple "eye" in the corolla mouth is a character which I have found in some forms of other species, but in this plant it appears always to be present. (v.v.s., v.v.c.)

Oxalis petraea, Salter (Oxalidaceae), § Tripartitae (Rotundatae).

Planta parva 3—5 cm. alta, caule non exserto, pilis brevissimis capitatis omnino dense pilosa. *Bulbi* anguste ovoidei, ad 1 cm. longi, tunicis numerosissimis laxe circumdati : tunicae lanceolatae vel subulatae vel lineares, saepe 2 cm. longae, atro-brunneae, ad apicem integrae acutissimae, saepe deflexae, inferne tripliciter defissae segmentis linearibus interdum undulatis. *Rhizoma* fere 6 cm. longum, ad apicem squamis 1—3 latissime ovatis membranaceis indutum. *Folia* 2—4, basalia, petiolis 0·5—1·5 cm. longis, inferne (infra articulum) dilatis : foliola 3, sessilia, utrinque margineque dense brevissimeque glanduloso-pilosa,

medium late obcordatum, ad basin late cuneato-attenuatum, leviter incisum, 4—7 mm. longum, 6—10 mm. latum, lateralia oblique rotundata, integra, paulo minora, supra (in vita) glauca, infra callis numerosis brunneis, praecique ad marginem instructa. *Pedunculi* 1—5, uniflori, ad 2·5 cm. longi, ad basin manifeste articulati, apice vel paulo infra calycem bibracteati bracteis alternantibus subulatis, 1—2 mm. longis.

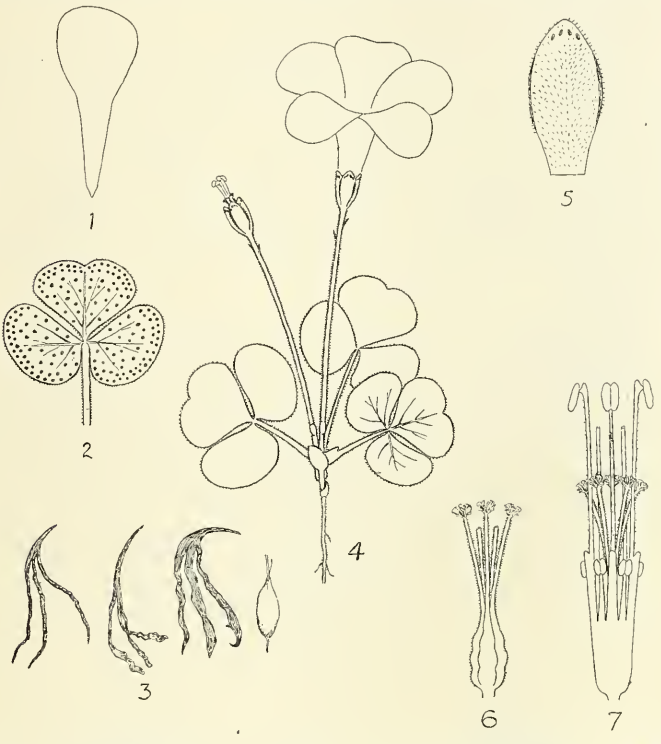


Fig. 6. *Oxalis petraea* Salter. 1. Petal × 1½. 2. Leaf, under side × 2. 3. Bulb and scales, natural size. 4. Plant × 1½. 5. Sepal × 6. 6. Gynaecium × 8. 7. Androecium, showing styles × 8. (*Salter* 5354.) *Del.* T. M. Salter.

Sepala anguste obovata, obtusa vel vix acuta, fere 4 mm. longa, ciliata, margine nonnihil purpurascentia, ad apicem callis 4 rubris saepe notata. *Corolla* 1·6—2·1 cm. longa, dense glanduloso-pilosa, obscure rosea, tubo infundibuliforme luteo : petala, e basi cuneato-unguiculata superne obovata, oblique subtruncata, saepe 1·9 cm. longa, 0·8 cm. lata. *Filamenta* (parte connata inclusa) exteriora 2·5—3·5 mm., glabra, interiora

4—6 mm. longa, obtuse breviterque dentata, sparse glanduloso-pilosa, longissima apice rostrata. *Ovarium* oblongo-ovoideum, 1·6 mm. longum, omnino glanduloso-pilosum, ecallosum, loculis 3-ovulatis, stylis dense breviterque glandulosis.

Hab. Cape Province: Van Rhyn's Dorp Div.; 11 miles north of Van Rhyn's Dorp in fissures in an outcrop of shale, 17 May 1935, *Salter* 5354 (*type* in Bolus Herbarium).

An affinity of *O. minima*, Sond. The whole plant, however, with the exception of the bulb, is densely clothed with very short gland tipped hairs and it also differs in having a dull, rather chalky pink corolla with a narrower tube, fewer leaves, darker bulb tunics and the longest filaments rostrate at the apex. The bulbs, like those of *O. minima** are embedded in a dense mass of loose splitting tunic-scales which seem to serve as an insulation from the heat. They fall away readily and the whole structure is somewhat difficult to remove from the earth intact. The dense indument on the upper surface of the leaflets is only visible under powerful magnification.

Oxalis reflexa, Salter (Oxalidaceae), § Tripartitae (Rotundatae).

Planta parva, caule non exserto vel breviter exserto, partibus herbaceis omnino glabris. *Bulbus* ovoideus vel anguste ovoideus, saepe 2·5 cm. longus, tunicis rigidis, apice curvato-attenuatis, acutissimis, atro-brunneis. *Rhizoma* fere 5 cm. longum, squamis nonnullis late ovatis cuspidatis amplexicaulibus membranaceis indutum. *Caulis* nil vel brevis, sicut rhizoma squamatus. *Folia* 2—6, basalia vel ad caulis apicem conferta, petiolis 0·5—2 cm. longis: foliola 3, sessilia, subcrassa, (in sicco) utrinque impresso-punctata, medium latissime rotundatum vel transverse ellipticum ad basin leviter attenuatum, emarginatum, 0·6—1·1 cm. longum, 0·7—1·5 cm. latum, lateralia minora, oblique rotundata vel elliptica, integra. *Pedunculi* ad 6, uniflori, e axillis foliorum vel squamorum caulis exorientes, folia valde superantes, 2·5—5·0 cm. longi, paulo infra calycem bibracteati bracteis minutis linearibus alternantibus. *Sepala* oblonga vel lineari-oblonga, obtusa, 4·5—6 mm. longa, plerumque atro-purpurascentia, apice callis 2 inconspicuis rubris ornata. *Corolla* purpurea, tubo infundibuliforme luteo: petala anguste cuneata, antice oblique subtruncata vel leviter retusa, 1—1·4 cm. longa, 3·5—4 mm. lata, valde reflexa. *Filamenta* (parte connata inclusa) exteriora 2—3·5 mm. glabra, interiora 3·5—5·5 mm. longa, glanduloso-pilosa, edentata. *Ovarium* late oblongum, glabrum vel in dimidio superiore glandulosum, superne callis elongatis ornatum, stylis glandulosis. *Capsula* subglobosa, loculis 8-ovulatis.

* See Journ. S.A. Bot., Vol. I, page 114 footnote.

Forma β (vix var.). *Corolla* alba.

Hab. Cape Province: Van Rhyn's Dorp Div.; 16 miles north-east of Van Rhyn's Dorp on stony hillsides, flowers May—June, *Salter* 5318

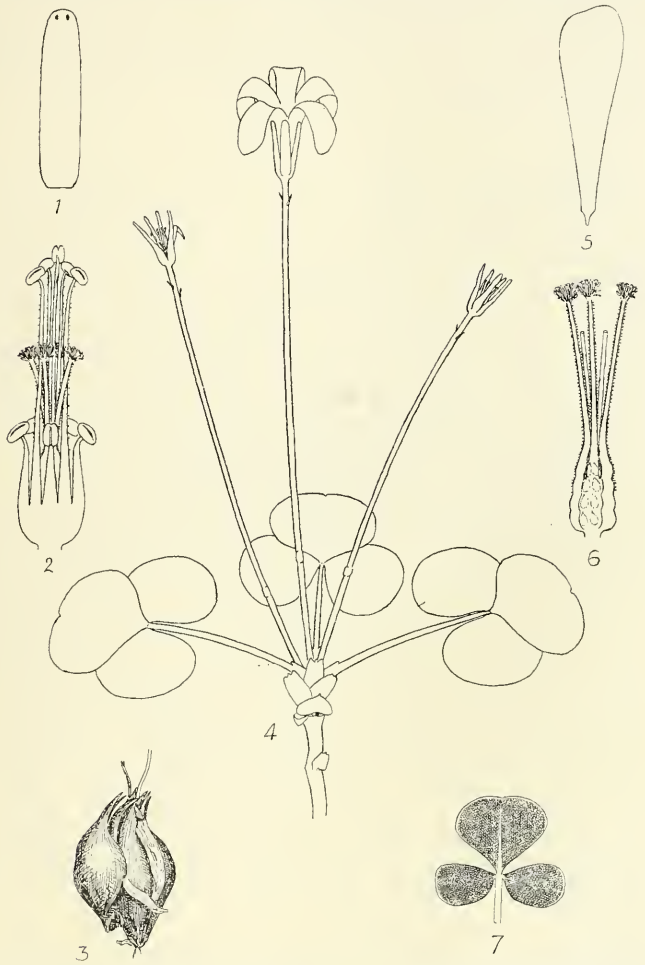


Fig. 7. *Oxalis reflexa* Salter. 1. Sepal × 6. 2. Androecium, showing medium styles × 8. 3. Bulb, natural size. 4. Plant × 2. 5. Petal × 3. 6. Gynaecium × 8. 7. Underside of a leaflet (dried) × 2. (*Salter* 5318.) *Del.* T. M. Salter.

(*type* in Bolus Herb.) and 2495; Calvinia Div.; 11 miles north of Nieuwoudtville, *Salter* 4561: β. 15 miles north-east of Van Rhyn's Dorp.

A close affinity of *O. Dammeriana*, Schltr. and *O. Pocockiae*, L. Bolus, but differs in having much smaller flowers with narrower *reflexed* petals, a callose ovary and entirely glabrous sepals. The bulb is smooth and not 4-winged as in *O. Pocockiae*.

The white form which is probably only a colour variant was found about 1 mile away from the typical purple form. Both were fairly plentiful in their respective localities, but the two colours do not appear to grow in association.

Oxalis stenopetala, Salter (Oxalidaceae), § Tripartitae (Lineares).

Planta gracilis, caule exserto, 8—15 cm. alta. *Bulbus* anguste ovoideus, attenuatus vel saepe tortuose rostratus, 2—3 cm. longus, tunicis rigidis atro-brunneis. *Rhizoma* fere 6 cm. longum, squamis paucis amplexicaulibus instructum. *Caulis* gracilis rigidus, 3—14 cm. longus, minute adpresso-pubescens, atro-viridis, interdum squamis 1—2 indutus. *Folia* 9—13 petiolata, apice caulis aggregata, rare inferiora, petiolis filiformibus, adpresso-pubescentibus, ad basin (infra articulum) dilatis, ciliatis : foliola 3, sessilia, anguste linearia, ad basin apicemque angustantia, conduplicativa, interdum levissime falcata, minute emarginata, 1—2·5 cm. longa vix 1 mm. lata, glabra, vel infra sparse pubescens, apice callis 2 minutis ornata. *Pedunculi* satis numerosi, uniflori, folia superantes, 4—6 cm. longi, post anthesin interdum deflexi, sparse pubescentes, in parte superiore bibracteati bracteis linearibus 1—2 mm. longis. *Sepala* lanceolata, attenuata, 4—4·5 mm. longa, praecipue ad basin pubescentia, ciliata, ad apicem purpurascentia, apice callis 2 rubris instructa. *Corolla* 1·9—2·5 cm. longa, alba, tubo breve luteo (in sicco a limbo vix discreto) : petala spathulata, 5—6 mm. lata, apice saepe leviter oblique truncata, fugacia. *Filamenta* (parte connata inclusa) exteriora 2·5—4·5 mm., glabra, interiora 3·5—6·5 mm. longa, externe dense glanduloso-pilosa, dentibus fere 0·3 mm. longis. *Ovarium* oblongum, 2—2·3 mm. longum, superne pubescens, ecallosum, stylis ad basin pubescentibus, superne dense glanduloso-pilosis. *Capsula* elongata, pubescens, loculis 4—6-ovulatis.

Forma β (vix var.). *Planta* major ad 20 cm. alta, caule robustiore, interdum breviter ramuloso. *Folia* ad 27 : foliola latiora, ad 2·5 mm. lata, margine callis numerosis atris ornata. *Sepala* breviora. *Petala* paulo latiora. *Antherae* majores.

Hab. Cape Province : Clanwilliam Div. ; 10 miles south-west of Doornbosch, near Lieut. Clowe's grave in open ground, flowers May—July, *Salter* 2469 (*type* in Bolus Herbarium) : Calvinia Div. ; between Doornbosch and Karamoe, *Salter* 2475, 4448, about Nieuwoudtville 1649C. (cult), 4560. Form *β*, 14 miles East of Nieuwoudtville, 4470A.

An affinity of *O. falcata*, Sond. and *O. polyphylla*, Jacq. but more slender and differing from them in having much narrower fugacious petals and fruiting capsules elongating well beyond the calyx. Some starved specimens superficially resemble *O. campicola*, Salter, but may

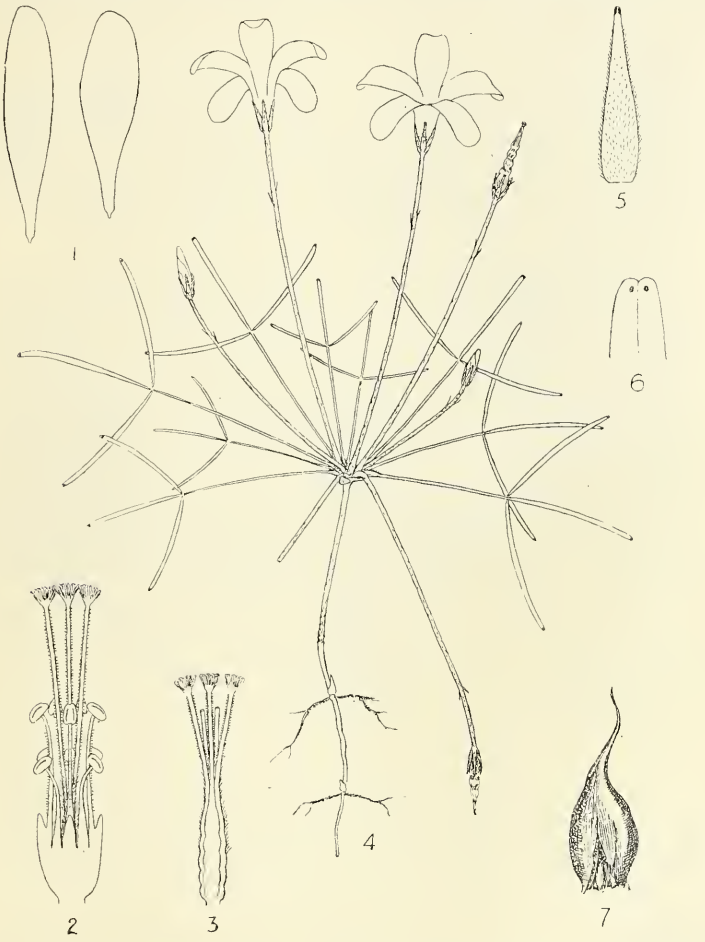


Fig. 8. *Oxalis stenopetala* Salter. 1. Petals × 1½. 2. Androecium, showing long styles × 8. 3. Gynaecium × 8. 4. Plant, natural size. 5. Sepal × 6. 6. Tip of leaflet (underside) × 6. 7. Bulb, natural size. (*Salter* 2469.) *Del.* T. M. Salter.

be distinguished by the bulb, narrower petals, differently shaped sepals and glandular, not pluricellular indument on the styles. (v.v.s., v.v.c)

Form β may be due to luxuriant growth but is more probably an extreme mutant. Although the differences are marked it can scarcely be distinguished as a variety, as specimens showing intermediate characters have been found.

ARACHNOCALYX, R. H. Compton, gen. nov. (Ericaceae-Ericoideae).

Bracteae 3, approximatae. Calyx 4-partitus, segmentis subaequalibus. Corolla ovoidea, puberula, lobis brevibus 4. Stamina 6—8, inter se libera, antheris exsertis, bipartitis, appendiculatis. Ovarium 2-loculare, compressum, in quoque loculo una ovula subbasalia, stylo exserto, stigmate simplice. Genus adhuc monotypicum.

Arachnocalyx Cereris, R. H. Compton, sp. nov.

Fruticulus diffuse ramosus. *Caules* rigidi, pilis albis floccosis, nonnullis setis longis rectis glandulosis tecti, subglabrescentes. *Folio* 3-nata, patentia vel erecto-patentia, subter convexa, sulcata, supra plana, long. (petiolo incluso) 3—6 mm., lat. 0·7—1·0 mm., juventute griseo-viridia, utrinque pilis albis, floccosis, atque, praesertim subter et in marginibus, setis longis, glandulosis, longitudine inaequalibus, indutis, demum glabrescentia, viscidula, setarum defluentium basibus aspera. *Inflorescentia* terminalia, subumbellata, floribus 5—10, erectis vel subcernuis : pedicelli, bracteae calyxque rubidi, pubescentia sparsa, floccosa, nonnullis pilis brevibus, glandulosis, atque setis numerosis, longis, albis, rectis, induti. *Pedicellus* long. c. 3 mm. *Bracteae* approximatae, linearilanceolatae, infima long. 2 mm., caeterae long. 1·5 mm. *Sepala* libera, subaequalia, lineari-lanceolata, supra glabra, apice subsulcata, long. 2·5 mm., lat. 0·5 mm., ad corollam appressa. *Corolla* purpureo-tincta, dense et minute puberula, accurate ovoidea, long. 4 mm., diam. 2 mm., lobis brevibus, orbiculatis, obtusis. *Stamina* 6—7—8. *Filamenta* recta, applanata, alba, long. 4 mm. *Antherae* fuscae, breviter exsertae, oblongae, obtusae, long. 1 mm., bifidae cellulis erectis, aristis 2 brevibus, subulatis, deflexis, subbasalibus. *Ovarium* in disco fusco sessile, compressum, subquadratum, obtusum, hirsutum, loculis 2, uniovulatis. *Ovulae* in placenta axile subbasaliter insertae. *Stylus* glaber, long. 3 mm. *Stigma* leviter exsertum, simplex, haud incrassatum.

Hab. Cape Province : Ceres Division, without exact locality. Ceres Wild Flower Show, 2nd October 1933. *Compton* 4424. (*Type* in Herb. Bolus.)

This plant does not fit well into any established genus of Ericaceae. It appears to come nearest to the monotypic genus Hexastemon, Klotzsch, but differs therefrom by the number of the stamens which may be 6,

7 or 8 in different flowers on the same branch. Moreover the anthers are only just exserted and are aristate ; the corolla is circular in section, not angular, and is puberulous ; the ovules are attached near the base of the septum ; the ovary is hirsute : in all these respects it differs from the single species *Hexastemon lanatus* Kl. From Grisebachia, Klotzsch

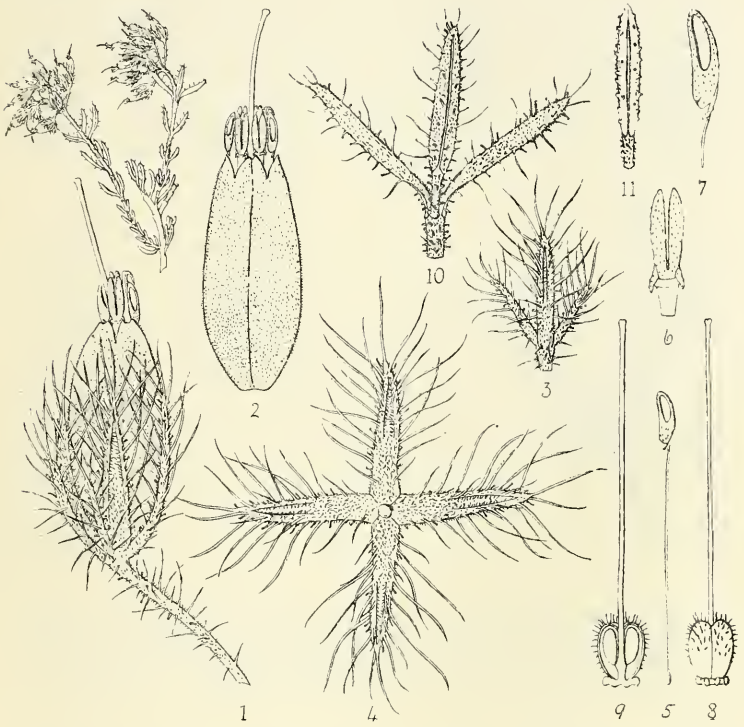


Fig. 9. *Arachnocalyx Cereris* Compton. (Natural size.) 1. Flower × 9. 2. Corolla × 9. 3. Bracts × 9. 4. Calyx, basal view × 9. 5. Stamen × 9. 6. Anther, back view × 18. 7. Anther, side view × 18. 8. Gynaecium × 9. 9. Longitudinal section of gynaecium × 9. 10. Whorl of leaves × 4½. 11. Old leaf × 4½. (*Compton* 4424.) *Del.* W. F. Barker.

and Eremia, D. Don it appears to be even more distinct. As a genus it appears to have equal validity with several of the other genera of Ericaceae diagnosed by N. E. Brown in the Flora Capensis, and it would appear more convenient to establish a new genus for it than to attempt to force it into an existing one.

The plant was exhibited at the Ceres Wild Flower Show, 2nd October 1933, and while it can be taken as certainly native in the Ceres Division no precise locality can at present be given for it.

Eremia calycina, R. H. Compton. (Ericaceae—Ericoideae.)

Fruticulus erectus vel diffusus. *Ramuli* tenues, subflexuosi, juventute dense griseo-puberuli pilis crispis. *Folia* 3-nata, internodiis subaequantia, erecta, appressa, oblongo-elliptica, apice subcucullata, base subgibbosa, sulcata, long. 1·5—2·0 mm., lat. 0·7 mm., utrinque glabra marginibus ciliolatis. *Flores* 1—5-nati, terminales vel laterales, deflexi vel subcernui, subsessiles. *Bracteae* 3, subaequales, oblongae, obtusae, scariosae, marginibus puberulis. *Calyx* late campanulatus, glaber, scariosus,

Fig. 10. *Eremia calycina* Compton. (Natural size.) 1. Flower × 12. 2. Corolla × 12. 3. Lower bract × 12. 4. Calyx, basal view × 12. 5. Sepal, from within × 12. 6. Stamen × 12. 7. Anther, back view × 24. 8. Anther, side view × 24 9. Gynaecium × 12. 10. Longitudinal section of gynaecium × 12. 11. Whorl of leaves × 12. (*Compton* 4939.) *Del.* W. F. Barker.

pallide roseo-tinctus: *tubus* long. c. 1·0 mm., diam. c. 1·0 mm.: *segmenta* late orbiculata, obtusa, inflexa, late cucullata, ad apicem carinata, long. c. 0·9 mm., exteriora 2 lat. c. 1·5 mm., interiora 2 lat. c. 1·3 mm., marginibus parum serrulatis. *Corolla* glabra, roseo-tincta: *tubus* obconicus, long. 1·3 mm.: *segmenta* orbiculata, parum inaequalia, long. ad 1·0 mm., erecta vel inflexa. *Stamina* 8, libera. *Filamenta* filiformia, contorta. *Antherae* bilobatae, loculis ovoideis, scabridis, castaneis, long. 0·4 mm., aristatis. *Ovarium* in disco fusco, breve lobato, ovoideum, compressum, supra puberulum, loculis 2, uniovulatis, ovulis apicalibus, pendentibus. *Stylus* tenuis, long. 2·5 mm. *Stigma* longe exsertum, simplex, parum incrassatum.

Hab. Cape Province : Ceres Division : Cold Bokkeveld, Rosendal, 3,000 ft. alt., 29 September 1934. *Compton* 4939. (*Type* in Herb. Bolus.)

Distinguished by the large broad calyx segments which are inflexed and broadly cucullate at the apex, and which exceed the corolla tube in length. The anthers are included and the style long-exserted.

Eremia peltata, R. H. Compton (Ericaceae—Ericoideae).

Frutex erectus ramosissimus. *Ramuli* tenues, griseo-puberuli pilis deflexis. *Folia* 3-nata, internodiis parum longiora, erecta, oblonga, obtusa, sulcata, long. 2·0 mm., lat. 0·8 mm., laete virentia, utrinque glabra, marginibus angustissime scariosis, minute denticulatis. *Flores* 1—5-nati, terminales, erecti vel subcernui. *Pedicellus* long. 1·0 mm. *Bracteae* in

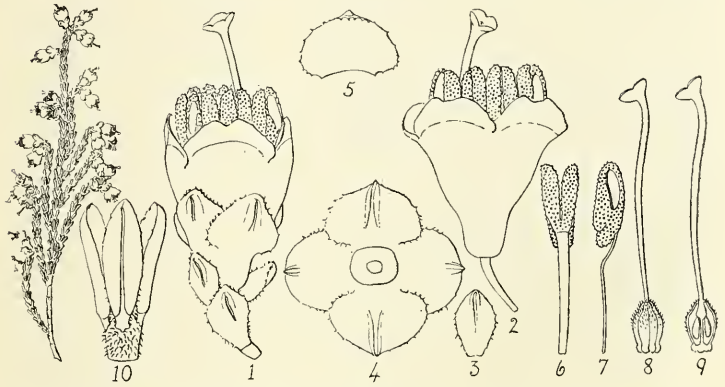


Fig. 11. *Eremia peltata* Compton. (Natural size.) 1. Flower × 12. 2. Corolla × 12. 3. Lower bract × 12. 4. Calyx, basal view × 12. 5. Sepal, from within × 12. 6. Stamen, back view × 12. 7. Stamen, side view × 12. 8. Gynaecium × 12. 9. Longitudinal section of gynaecium × 12. 10. Whorl of leaves × 12. (*Compton* 4921.) *Del.* W. F. Barker.

pedicello sparsae, ovatae, scariosae, long. c. 1·2 mm., glabrae, marginibus denticulatis. *Calyx* campanulatus, roseo-tinctus, scariosus, glaber, 4-partitus, *tubus* long. 0·5 mm., subquadratus : *segmenta* orbiculata, long. et lat. c. 1·2 mm., obtusa, subcucullata, sulcato-carinata, marginibus denticulatis. *Corolla* campanulata, roseo-tincta, glabra : *tubus* base obconicus, long. 1·5 mm. : *Segmenta* late orbiculata, long. 0·7 mm., lat. 1·5 mm., obtusa, minute crenulata. *Stamina* libera, 8, interdum sed rare 6. *Filamenta* recta, long. 1·5 mm. *Antherae* semi-exsertae, dorsifixae, bipartitae, loculis ovoideis, castaneis, scabridis, muticis, long. 1·2 mm. *Ovarium* in disco parvo, ovoideum, compressum, puberulum, loculis 2,

uniovulatis : *ovulae* subapicales, pendentes. *Stylus* tenuis, glaber, long. 3 mm. *Stigma* longe exsertum, peltato-crateriforme, parum 4-lobatum.

Hab. Cape Province : Ceres Division : Ceres Wild Flower Show, 1 October 1934, *Compton* 4921 (*type* in Herb. Bolus) ; and in October 1925, *Pillans* in Herb. Bolus 18421. Near Matroosberg, 4,000 ft. alt., September 1924, *Levyns* 957.

Noteworthy in the genus for its long-exserted style and expanded peltate-crateriform stigma : another feature is the more pronounced sulcate carinate midribs of the sepals which are continued downwards as four slightly prominent rounded angles on the calyx tube. The general appearance of the flower is similar to that of *E. calycina*, but the corolla tube is definitely longer than the calyx. There can be no doubt that

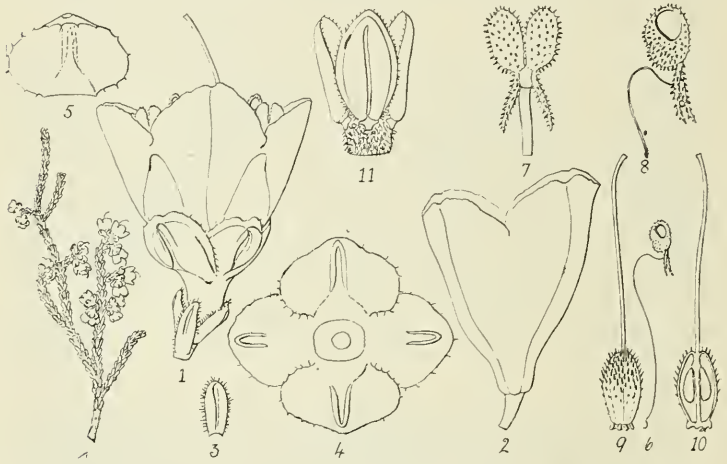


Fig. 12. *Eremia virgata* Compton. (Natural size.) 1. Flower × 12. 2. Corolla × 12. 3. Lower bract × 12. 4. Calyx, basal view × 12. 5. Sepal, from within × 12. 6. Stamen × 12. 7. Anther, back view × 24. 8. Anther, side view × 24. 9. Gynaecium × 12. 10. Longitudinal section of gynaecium × 12. 11. Whorl of leaves × 12. (*Compton* 4933.) *Del.* W. F. Barker.

these two species are closely related, and it would therefore appear desirable to enlarge the current definition of the genus *Eremia* to permit the inclusion of plants with an expanded stigma.

Eremia virgata, R. H. Compton (Ericaceae—Ericoideae).

Fruticulus erectus, virgatus. *Ramuli* tenues, erecti, juventute dense griseo-puberuli, pilis crispis. *Folia* 3-nata, erecta, imbricata, late elliptica, obtusa, base subbigibbosa, sulcata, long 1·2—1·5 mm., lat. 0.6—0.7

mm., utrinque glabra, marginibus ciliolatis. *Flores* 1—5-nati, terminales vel laterales, erecti vel subcernui. *Pedicellus* long. 0·5 mm. *Bracteae* 3, subbasales, erectae, oblongae, obtusae, long. 0·8 mm., roseo-tinctae, marginibus ciliolatis. *Calyx* campanulatus, 4-partitus : *tubus* long. 0·5 mm. : *segmenta* rigide scariosa, roseo-tincta, late orbiculata, extra convexa, long. 1·0 mm., exteriora 2 lat. 1·7 mm., interiora 2 lat. 1·5 mm., apice sulcato-carinata, marginibus ciliolatis. *Corolla* glabra, obconico-campanulata, roseo-tincta : *tubus* long. 1·7 mm. : *segmenta* interdum parum inaequalia, orbiculata, obtusa, long. c. 1·0 mm., lat. 1·2 mm., marginibus crenulatis. *Stamina* 8, libera. *Filamenta* filiformia, flexa. *Antherae* manifestae, bipartitae, loculis ovoideis, scabridis, long. 0·5 mm., aristis fuscis, tenuibus, long. 0·5 mm. *Ovarium* in disco parvo, fusco, ovoideum, puberulum, loculis 2, uniovulatis, ovulis subapicalibus, pendentibus. *Stylus* tenuis, interdum deflexus, long. c. 2·5 mm. *Stigma* exsertum, parvum, simplex, obconicum.

Hab. Cape Province : Ceres Division, exact locality not known. Ceres Wild Flower Show, 1 October 1934, *Compton* 4933 (*type* in Herb. Bolus).

Well distinguished in the genus by its erect virgate or tufted growth and its very short appressed leaves.

Eremia florifera, R. H. Compton. (Ericaceae—Ericoideae.)

Frutex erectus ramosissimus. *Caules* tenues, puberuli, internodiis plus minusve elongatis, ramulis lateralibus subfasciculatis. *Folia* erecto-patentia, 3-nata, lineari-oblonga, sulcata, obtusa, juventute setoso-hispida, subglabrescentia, in caulis principalibus long. ad 3·5 mm., lat. 0·5 mm., in ramulis lateralibus breviora. *Flores* numerosissimi, in cumulis parvis terminalibus vel lateralibus aggregati. *Pedicellus* long. 1·3 mm. *Bracteae* 3, subremotae, infima long. 1·9 mm., alterae long. 0·6 mm., oblongae, scariosae, dorso et marginibus leviter puberulis. *Calyx* profunde 4-partitus : *tubus* long. 0·3 mm. ; *segmenta* ovata, patentia, long. 0·7 mm,. lat. 0·5 mm., dorso et marginibus puberulis. *Corolla* rosea, glabra, cyathiformis, base leviter contracta : *tubus* long. 1·5 mm. : *segmenta* obtusa, integra, long. 0·4 mm. *Stamina* 8, libera. *Filamenta* filiformia, long. 1·2 mm. *Antherae* fuscae, laeves, bifidae, long. 0·4 mm., aristis longis, pallidis, scabridis. *Ovarium* in disco parvo oblongo-ovoideum, supra puberulum, loculis 4, uniovulatis, ovulis subapicalibus, pendentibus. *Stylus* robustus, long. 0·7 mm. *Stigma* inclusum, obconicum, apice puberula.

Hab. Cape Province : Ceres Division ; exact locality unknown. Ceres Wild Flower Show, 1 October, 1934. *Compton* 4927 (*type* in Herb. Bolus.)

This plant bears a close resemblance to the section Arsace of the genus Erica. For instance, *Pappe* 39, from Witsenberg Vlakte, near Ceres, placed by Guthrie and Bolus as a variety of *Erica copiosa* Wendl., but apparently distinct from the more southern gatherings of that species, is very similar in almost every character except for the ovary which contains numerous ovules, whereas *Compton* 4927 shows a single ovule in each of the four loculi. Such a plant as *Eremia florifera* acts as a connecting link between the genus Erica and some of the "minor genera" of the Ericoideae.

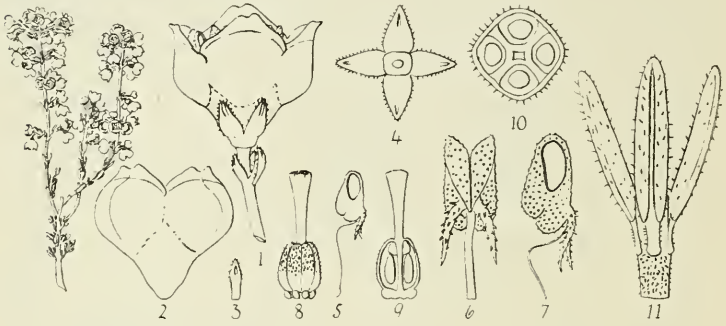


Fig. 13. *Eremia florifera* Compton. (Natural size.) 1. Flower × 12. 2. Corolla × 12. 3. Lower bract × 12. 4. Calyx × 12. 5. Stamen × 12. 6. Anther, back view × 24. 7. Anther, side view × 24. 8. Gynaecium × 12. 9. Longitudinal section of gynaecium × 12. 10. Transverse section of ovary × 24. 11. Whorl of leaves × 12. (*Compton* 4927.) *Del.* W. F. Barker.

The above additions to the genus Eremia have the effect of approximately doubling its size, on the basis of the species included in it by N. E. Brown in the *Flora Capensis*. They also result in a modification of one's conception of the genus, the best known species of which, *Eremia totta* D. Don, now appearing somewhat anomalous. The definition of the genus should also be enlarged to include such a feature as the long-exserted peltate-crateriform stigma of *E. peltata*. Otherwise the new species described above fit well into the genus as defined by Brown, though they certainly differ considerably in habit and in floral physiognomy among themselves and their previously described congeners. The genus is mainly localised in the Ceres and Clanwilliam Divisions.

I append a short Key for the diagnosis of the eight (seven, excluding *E. parviflora*), species now recognised.

EREMIA D. DON.

Ovary 4-locular	
Anthers aristate, stigma included	*florifera*
Anthers muticous, stigma exserted	*totta*
Ovary 2-locular	
Stigma peltate-crateriform	*peltata*
Stigma not peltate-crateriform	
Anthers muticous, sepals linear	*brevifolia*
Anthers aristate, sepals broader	
Calyx as long as corolla	(*parviflora*)*
Corolla longer than calyx	
Leaves reflexed, setose	*recurvata*
Leaves more or less erect, not setose	
Corolla tube exceeding calyx..	*virgata*
Corolla tube not exceeding calyx	*calycina*

* It is doubtful whether *Eremia parviflora* Klotzsch, exists. N. E. Brown (Fl. Cap IV., 1, 334), included it under *Eremia* without seeing it, but on a later page (*ibid.* 349), stated that the type was in reality *Grisebachia eremioides* McOwan.

TARAXACUM MAGELLANICUM COMM. IN SOUTH AFRICA.

By J. Burtt Davy.

In 1903 the present writer collected specimens of a species of Taraxacum growing in somewhat marshy, unbroken vlei ground bordering the Mooi River, near Potchefstroom, Transvaal. This was identified (*e descriptione*) with that little known species *Taraxacum fulvipilis* Harv., the type of which, however, was not available for comparison. A study of South African material at Kew brought to light a specimen of the same species collected by Burchell in 1812, in a remote and then wholly unsettled area of British Bechuanaland, on the fringe of the Kalahari, about 200 miles to the north of the Transvaal locality.

The type specimen of *Taraxacum fulvipilis* was collected in the Queenstown Division, Cape Province, approximately 400 miles south-east of Potchefstroom.

The occurrence of isolated specimens of a peculiar and supposedly endemic species of Taraxacum, in three such remote areas as the Queenstown, Potchefstroom, and Kuruman districts, aroused my curiosity, and led to the examination of other Southern Hemisphere material of the genus Taraxacum. Comparison with South American and New Zealand specimens of *Taraxacum magellanicum* Comm., collected by Coppinger, Haast, and others, failed to show any specific difference between them and the South African plant.

The Potchefstroom specimen had every appearance of being truly feral, occupying wet vlei ground which was apparently unbroken, and was unlikely ever to have been cultivated. This fact, and the occurrence of the same species, in such a remote locality as the Moshowing River, remove any suspicion of possible human introduction, such as has occurred in the case of *T. officinale* Weber in the Transvaal. These facts suggest, also, the desirability of a careful investigation of the flora of uncultivated vlei-lands.

The distribution and synonymy of the species may be summarized as follows :

Taraxacum magellanicum Comm. in Sch. Bip. Flora 38 : 122 (1855). *T. officinale* Weber var. *laevigatum* Hook. f., Fl. Antarct. 1 : 323, t. 112 (1844-7) ; *T. fulvipilis* Harv. in Harv. & Sond. Fl. Cap. 3 : 527 (1865)?

South America. Chile : pampas of Magellan *Coppinger* (type). Argentina : Andes of Mendoza *Gillies*. Patagonia : *Darwin*. Tierra del Fuego : *Banks and Solander*. Falkland Islands : *J. D. Hooker*.

Australasia. New Zealand: without precise locality *Banks and Solander.* Ashburton Glacier, 4,700 ft. alt. *Haast.* Chatham Islands: *Travers.*

South Africa. Transvaal: Potchefstroom District, on marshy vlei-land subject to flood, along the Mooi River, near Potchefstroom, circa 4,500 ft. alt. Dec. 26, 1903 *Burtt Davy* 1030. British Bechuanaland: Kuruman Division, at the sources of the Moshowing ("Moshowa") River, near Takoon (ca. 27° S. Lat.), in 1812 *Burchell.* The type of *T. fulvipilis* Harv. in the Sonder Herbarium, which I have not seen, was collected by Drège in the Queenstown Division, Cape Province, "zwischen Los Tafelberg und Wildschutsberg, auf der Fläche, 4000 fuss, December".

The occurrence of *Taraxacum magellanicum* Comm. in South Africa thus furnishes the missing link in the circumpolar range of this Southern Hemisphere species. Hooker (*Flora of New Zealand*, p. 152) treating it as a variety (var. *laevigatum*) of *T. officinale*, stated that it was native to both "the Falkland Islands and Fuegia, where . . . . it has been gathered in a certainly native state," adding: "it occurs in the collections of Banks and Solander, made in New Zealand, from which, as well as the fact that the prevalent varieties collected by these voyagers and by Mr. Colenso differ from the ordinary British form (*T. officinale* Weber), confirm the opinion of the plant being truly indigenous." Handel-Mazetti maintains it as a distinct species.

In general appearance this species is not unlike *T. phymatocarpum* J. Vahl, of Novaya Zemlia.

DIAMETER GROWTH RHYTHM IN *ACACIA MELANOXYLON* R. Br. ("Tasmanian Blackwood") AS SHOWN BY DENDROGRAPHIC OBSERVATIONS ON THE WITWATERSRAND.

By John Phillips.

Through the kind assistance of the Chief of the Division of Plant Industry, Dr. I. B. Pole Evans, I have been able to investigate growth rhythm phenomena in several species of trees, off and on, during the past nine years, by means of MacDougal's dendrograph. I have published (Phillips 1927; 1931) certain data for Stinkwood (*Ocotea bullata*, E. Mey.) and Hard Pear (*Olinia cymosa*, Thunb.), and desire in this communication to refer to certain phenomena of interest in *Acacia melanoxylon*.

As I have described—in an earlier paper—in some detail (Phillips 1927: 228) MacDougal's dendrograph, and have dealt therein with the physiological phenomena responsible for the diurnal changes in diameter termed "reversible variations", it is my intention to proceed directly to a summarised consideration of certain features of interest in the Blackwood. A fuller treatment of several important relations is reserved for a later paper.

Observations Made and Their Objects.

Reversible variations in diameter—or volume—of bole, due to changes in water balance in relation to habitat conditions and time of day, have been recorded for a number of North American plants by MacDougal and his associates. They have been shown to occur in several South African trees—notably *Ocotea*, *Olinia cymosa*, and *Acacia caffra*, as the result of my own observations. It was desired to investigate the behaviour of a vigorous, water-voracious *evergreen* species during several years, in a climatic region showing very well marked warm-moist and cold-dry seasons.

Further, the nature of the growth rings—the so-called "annual rings"—exhibited by such a fast-growing *evergreen* in a region with well differentiated warm-moist and cold-dry seasons was a subject I strongly wished to investigate. Investigations carried out by me upon evergreen species in the Knysna forests during the years 1922-1927 failed to clear up the uncertainty regarding growth rings—whether they are *annual* or merely *periodic*—because there is insufficient differentiation, in that region, between so-called summer and so-called winter seasons.

As I required a species readily accessible, as well as one about which a certain amount of physiological-ecological information was known to me from my own researches, I selected the Blackwood. A vigorous pole-stage tree about 30 ft. high, and 6 inches diameter at breast-height, growing in my ecological experimental plots, Crescent Creek, Milner Park, Johannesburg, was selected. This tree had its crown well supplied with light and space, and was rooted in red loam of good depth, and satisfactory physico-chemical nature.

A MacDougal dendrograph was fitted to this tree on December 22nd, 1931, and until January 14th, 1932, was so adjusted that the quartz rod of the recording mechanism was touching the outer and undisturbed surface of the bark. As it was found that heavy downpours of rain were liable to bring about swelling in the bark, the quartz rod from 15th January, 1932 until 18th March 1935, was placed so that it rested against a very thin covering of tissue protecting the living tissues themselves. (*vide* Phillips 1927 : 228.) The rod was set so as to record changes *multiplied by* 20.

Thermograph, hydrograph, evaporation, rainfall, sunshine, photometric and soil temperature data were available from the ecological plots.

During the lengthy course of the observations the tree was in no way disturbed, nor was the habitat altered ; the tree remained vigorous throughout.

Phenomena of Interest.

I. Reversible Variations.

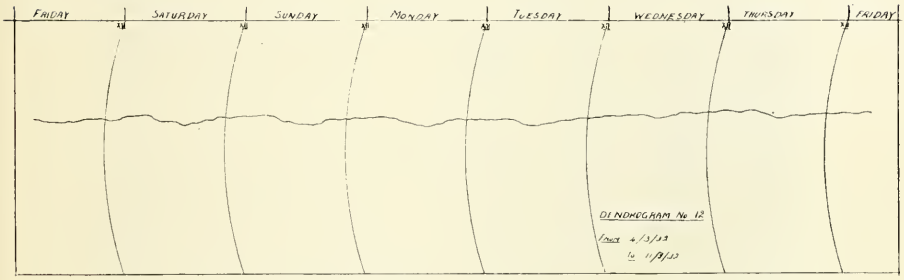
Reversible variations were clearly and consistently shown, throughout the period of $3\frac{1}{4}$ years, the magnitude of these varying considerably with *season*, and with the particular weather conditions of any given *day*. An example of the variations is given in the *diagram*, for the week beginning March 4th, 1932.

The variations were much more marked in the warm-moist season than in the cold-dry (May-September), becoming very much reduced in the months of June to July, and being somewhat larger in August and September ; from October they appreciably increased. It is interesting, however, to note that during the excessively wet period, November 1st, 1933—April 30th, 1934, the magnitude of the variations, on the whole, was less than in the corresponding seasons of 1932 and 1933. Such variation in magnitude probably is connected with change in root-absorption and transpiration responses and ratio.

On some days in the warm-moist season, a decreased water balance would be indicated as beginning about 7 a.m., and ending about 6 to 8 p.m.; on other days in this season the decreased balance would be indicated as extending over shorter periods, e.g. from 8 a.m. to 6 p.m., according to aerial habitat factors. On days of the cold-dry season, the times of decreased water balance would extend from about 10 or 11 a.m. to about 4 to 5 p.m.

Maximum decrease in water balance usually was registered after 12 noon to 2 p.m., but naturally this depended closely upon the particular rhythm of aerial conditions for the day.

No definite connection between details of the reversible variations and such weather conditions as sudden downpours of rain, or intensely cold, sleety weather (e.g. as experienced in June, 1932) has been observed.



To summarise: Blackwood, an *evergreen* tree transpiring relatively large amounts of water vapour, has been shown to exhibit reversible variations in water balance, throughout the seasons of $3\frac{1}{4}$ years.

II. Permanent Increment.

Without attempting any detailed discussion of the phenomena exhibited so far as permanent increment is concerned, I desire to record the outstanding features:—

(1) As observations commenced on 22nd December, 1931 (above bark) and 15th January 1932 (below bark) respectively, I am unable to state the approximate dates when increment of permanent nature commenced in the season 1931-32. Increment continued until the week ending 27th May. The rainfall during the period 1st November 1931—30th April 1932 was 19·96 inches, on 69 days.

The tree *rested* from about 27th May to about the 18th August, 1932, *a period of a little over* $2\frac{1}{2}$ *months.*

As is evident from the table of soil temperatures at 1 foot, 2, 3 and 4 feet depths, there was a marked increase in soil temperature from October, 1932: this, along with the rainfall, undoubtedly would aid increase in absorption of solutes.

(2) In the season 1932-33, increment of permanent nature commenced about the week beginning the 18th August, 1932, ending in the week terminating on the 27th April, 1933: the growing season ending, thus, *about one month earlier* than in the season 1931-32. This probably is accounted for by the comparative severity of this season (1932-33), in terms of rainfall and its distribution. The total during the period 1st November, 1932—30th April, 1933, was 16·80 inches only, spread over 62 days—being 3·16 inches less than in the corresponding period for 1931-32. The difference in total rainfall, however, does not fairly represent the differences between the years, in terms of severity for plant life; the indigenous and exotic flora of the Witwatersrand undoubtedly experienced much more severe conditions in this year than in the year previous. Soil heat was much as in 1931-32.

The tree *rested* from about 27th April to about 30th October, 1933: *a period of about 6 months.*

(3) Increment commenced for the season 1933-34 in the week beginning 30th October, 1933—and, as I have suggested already, this probably is to be accounted for by the severe drought conditions experienced during the period 1st Nov., 1932—30th April, 1933. At all events, increment commenced about $2\frac{1}{2}$ months later than in the year previous (October 30th in 1933 and compared with August 18th in 1932). Increment continued until the week ending 23rd July, 1934 . . . *two months longer than in the season* 1932-33. The rainfall during the period 1st November, 1933—30th April, 1934, was as high as 33·10 inches, on 69 days, the months of November (10·75 inches), December (5.51 inches) and January (11·79 inches) being particularly wet. There is undoubtedly a relation between the heavy rainfall and the extension of the growing season by two months.

The tree *rested* from about the 23rd July, 1934, until the week beginning 17th September, 1934: *a period of about* $1\frac{3}{4}$ *months.*

(4) It is seen, therefore, that the *resting* seasons were as follows: in 1932, about $2\frac{1}{2}$ months; in 1933 about 6 months; in 1934, about $1\frac{3}{4}$ months. It is also highly suggestive that the long *resting* period of 1933 is accounted for by the severe drought conditions experienced in the growing season. The very short *resting* period—$1\frac{3}{4}$ months—of 1934 may be accounted for by the higher soil moisture content, for which the heavy rains of the period 1st November, 1933—30th April, 1934, were responsible.

Mean Sub-Soil Temperatures at 8-30 a.m., Several Depths at Roots of Blackwood, Crescent Creek, January 1932—March 1935.

Month.		1 Ft.	2 Ft.	3 Ft.	4 Ft.
1932					
January ..	Growth period	67·57	67·30	66·00	65·00
February ..		66·33	66·05	65·21	64·76
March ..		63·32	63·79	63·77	63·71
April ..		59·35	60·83	61·45	61·79
May ..		52·31	55·95	57·37	58·90
June ..		47·73	52·15	54·32	56·09
July ..		45·09	50·03	52·21	53·86
August ..		48·90	51·10	52·14	53·36
September..		55·68	55·89	55·58	55·56
October ..		60·77	59·86	58·77	58·54
November..		61·92	62·57	61·65	61·04
December ..		66·47	65·40	64·08	63·39
1933					
January ..	Growth period	67·50	66·26	65·15	64·43
February ..		68·03	67·38	66·35	65·52
March ..		63·95	63·97	64·11	64·10
April ..		59·61	61·30	61·96	62·47
May ..		54·49	57·63	59·10	60·09
June ..		47·45	52·12	54·74	56·61
July ..		47·86	51·00	52·60	54·37
August ..		50·93	53·13	54·54	54·81
September..		54·92	55·14	55·68	56·00
October ..		61·08	60·20	59·47	59·02
November..		61·43	61·12	61·29	61·11
December ..		63·37	62·71	62·61	62·28
1934					
January ..	Growth period	64·58	64·26	64·09	63·69
February ..		63·62	63·94	63·98	63·94
March ..		62·13	62·64	62·90	63·23
April ..		58·77	60·44	61·16	62·21
May ..		52·80	55·54	57·60	59·91
June ..		48·64	51·53	54·57	56·91
July ..		46·98	50·29	53·46	55·27
August ..		50·22	52·23	53·34	55·05
September..		53·73	54·63	54·85	55·32
October ..		58·92	58·35	56·99	55·41
November..		60·09	58·86	57·93	55·65
December ..		62·44	—	61·88	—
1935					
January ..	Growth period	64·56	—	63·94	—
February ..		63·30	—	63·27	—
March ..		60·86	—	61·73	—

(5) From this study it is clear that each year there is *one* season of growth, *one* season of rest, and that periods of growth and rest do not sporadically alternate as they appear to do in trees of evergreen nature, in regions of the Union with less well differentiated warm-moist and cold-dry seasons.

As it is earnestly desired to know more about the *time* significance of rings of trees in the Union, in connection with climatological studies and plant succession, the results of the dendrographic observations above recorded are felt to be of some practical importance. Increment-borer and other checking and supporting methods are being given attention too, but the dendrographic method, in that it gives a continuous record of behaviour, sufficiently greatly magnified, is considered to be superior to any other so far used.

In connection with further work upon this important matter of nature of growth rings, and their indicator significance in connection with rainfall and other habitat conditions, I should mention that recently the dendrographic method has been applied to a widely spread indigenous tree, *Acacia caffra* (Katdoring; Kaffer wag 'n bietje), a tree deciduous in the greater portion of the cold-dry portion of the year, and therefore likely to show rings that are *annual*.

Summary.

(1) MacDougal's dendrograph has been used for $3\frac{1}{4}$ years upon *Acacia melanoxylon*, an evergreen exotic, in the Witwatersrand area.

(2) Reversible variations have been exhibited.

(3) Permanent increment is shown to occur in well defined seasons, hence it is indicated that the growth rings, the so-called "annual" rings, are truly produced one per year.

(4) The significance of the annual nature of the rings, in connection with meteorological work, is mentioned.

(5) A diagram of a typical dendrogram is given.

References.

MacDougal, D. T.: 1918, 59; 1919, 72; 1920, 51; 1921, 1924, 1925 . . . . cited in Phillips, 1927.

Phillips, John, 1927: "Dendrographic Experiments: *Ocotea bullata* E. Mey. (Stinkwood)"; S. Afr. Journ. Sci. XXIV, pp. 227-243.

Phillips, John, 1931: "Forest-succession and Ecology in the Knysna Region": diagrams v, viii, xi. Bot. Survey S. Afr. Memoir 14.

GERMINATION IN SOME SOUTH AFRICAN SEEDS.

By

Margaret R. Levyns,

Studies in the behaviour of seeds during their resting period and during germination have been carried out to a large extent in the cold temperate regions of the Northern hemisphere. Little seems to have been done in those parts of the globe, such as the south western corner of Africa, where climatic conditions are extremely different, and the experiments about to be described will therefore help to fill a gap in our knowledge.

The coastal belt in the south western part of the Cape Province has a climate of the Mediterranean type. Most of the rain falls during the winter months, and the summer is dry and hot. Frosts are extremely rare and really low temperatures are never experienced. The dormant period for most elements in the vegetation is during the summer months, and it is therefore obvious that in those seeds where the phenomenon of after-ripening is necessary before germination can take place, the factors involved are likely to be very different from those operative in the cooler parts of the North Temperate region.

Veld fires are all too frequent in South Africa, and over the whole coastal belt the vegetation has been profoundly modified by the incidence of fire. The germination tests recorded in this paper were started in connection with experiments in veld burning. At an early stage of the investigation it was obvious that fire stimulated the seedling growth of some plants, while in other cases it had no marked effect. It therefore became necessary to study the behaviour of the seeds of typical plants. The plants chosen were,

Elytropappus rhinocerotis Less.
Anthospermum aethiopicum L.
Relhania genistaefolia L'Herit.

Elytropappus rhinocerotis.

This plant is the notorious rhenoster bush of the Cape Province. It is a grey-green shrub, from eighteen inches to four fect in height, and covers extensive areas where the soil is fairly fine grained. In parts

of the country it has become a serious pest. At Stellenbosch where experiments in veld burning have been carried out (5) it has been shown that this plant has no power of establishing seedlings in untouched veld, but that after burning enormous numbers of young plants appear. If the old vegetation be cleared away but not burnt a small number of seedlings establish themselves, but these are negligible in comparison with the vast numbers that appear in response to burning. Clearly burning has some stimulating action on the seed, and it was with a view to analysing the factors concerned that these experiments were started.

The behaviour of the seed has been discussed in two previous publications (4, 6). In these it was established that the fruits are shed about the time of the first winter rains, but are immature and give a very low percentage of germinations when sown immediately. The cause of the failure to germinate appears to lie in the embryo itself and not in the fruit wall and testa. A period of after-ripening is obviously necessary and in subsequent years the capacity for germination is much greater. Up to 1929 (the date of the last publication on the subject), the figures obtained were fairly consistent, but since that date several important departures from the expected figures have been obtained in the tests. It is with the problem raised by these unexpected figures that the present paper is chiefly concerned.

Records for tests from 1925 to 1931 are given in Table 1. In all cases the seeds were sown on moistened filter paper in petri dishes. The experiments were started at the old University Buildings in Cape Town and figures obtained there are given in unshaded squares. During April 1929 the Botanical Department moved into the new University Buildings at Rondebosch, so during that year seed was stored during the Summer months in Cape Town as before but the tests were made in May at Rondebosch. These results are given in the dotted areas. All figures in areas shaded with diagonal lines were obtained at Rondebosch with seed that had been both stored and germinated there.

While in Cape Town it had been clearly shown (6) that heating the dry seed just before sowing, if not too prolonged or too intense, hastened the process of germination but had no effect on the ultimate figures. The results of the tests made in May 1929 when the temperatures recorded during the course of germination were very different from those experienced in previous years, supported the conclusion that temperature at the time of germination has no effect on the final germination figures.

The results obtained in 1930 and 1931 with seed that had been both stored and grown at Rondebosch were surprisingly poor. With the sole exception that the seed had been stored in the new University Buildings

at Rondebosch instead of in Cape Town, the conditions under which the tests had been carried out were identical with those obtaining in 1929 when the results conformed with those of previous years. The obvious conclusion to be drawn from the facts is that something during the period of storage must have affected the seed. The only factor that had varied in the course of the experiments was that of temperature. In Cape Town the room in which the seeds were stored was very hot in summer and cold in winter, while the room used for this purpose at Rondebosch had a more equable temperature.

TABLE 1.

Year in which seed was collected	1st year			2nd year			3rd year			4th year			5th year			6th year			7th year		
	Max.	Min.	Av	Max.	Min.	Av	Max.	Min.	Av	Max.	Min.	Av	Max.	Min.	Av	Max.	Min.	Av	Max.	Min.	Av
1925	4	1	3	—	—	—	69	51	55	60	39	47	60	35	47	30	16	21	7	1	3
1926	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
1927	4	1	2	56	33	42	65	51	59	54	43	47	40	28	35						
1928	4	1	3	60	53	55	58	37	45	54	33	41									
1929	—	—	—	47	19	27	31	20	26												
1930	—	—	—	34	26	29															

During the summer 1930-1931 some of the seed to be tested in the following May was placed out of doors, (*a*) protected from moisture in glass pots sunk in the ground, and (*b*) in muslin bags hanging up on branches of a rhenoster bush. Both lots of seed failed to give satisfactory results. The seed in the glass pots had obviously been injured by the very high temperatures experienced, while those in the muslin bags became mouldy and the moulds interfered with the results of the tests.

During the resting period of 1931-1932 a different procedure was adopted. Half the seed was stored as usual in the new University Buildings at Rondebosch and from August to May the other half was kept in the Herbarium of the South African Museum in Cape Town where the temperatures were similar to those of 1926-1929. In both places maximum and minimum thermometers were placed next the seed and records kept throughout the period. These were very different in the two places as will be seen from the figures given in Table 2.

In the first two columns the lowest daily temperatures experienced in each month are given for both places. In the next two columns the

highest daily temperatures are similarly given. It will be seen that for every month the highest and lowest temperatures were obtained in Cape Town. The most striking feature of these records, however, lies in a comparison of the daily range of temperature in the two places. The minimum and maximum range in 24 hours is given for each month and the average daily range is given in the last two columns. It will be seen that while the seed stored at Rondebosch experienced a very even temperature that in Cape Town was subjected to great daily fluctuations.

TABLE 2.—A Comparison of Room Temperatures in Centigrade at Rondebosch and Cape Town during the period of Seed Storage.

	Temperature Records.				Records of the daily range of Temperature.					
	Minimum		Maximum		Minimum		Maximum		Average	
	Rondebosch	Cape Town	Rondebosch	Cape Town	Rondebosch	Cape Town	Rondebosch	Cape Town	Rondebosch	Cape Town
1931										
August	10·6	5·0	19·4	22·8	1·7	7·2	4·2	17·8	2·8	11·7
September	10·3	5·0	19·2	28·9	1·9	6·7	4·4	12·8	3·3	9·4
October	12·8	5·6	19·4	25·0	2·2	7·2	3·3	16·1	2·8	11·1
November	14·7	11·1	26·7	35·0	2·2	7·7	5·6	17·8	3·1	11·1
December	16·7	11·1	23·9	32·8	1·7	8·3	5·6	15·6	3·3	11·1
1932										
January	17·2	11·7	23·9	32·2	1·7	8·9	3·3	12·2	2·8	10·6
February	18·9	13·9	28·3	36·7	1·9	7·7	5·0	12·8	3·3	10·6
March	17·8	11·1	24·2	29·4	1·7	10·0	5·6	15·6	3·1	11·7
April	14·7	9·4	25·0	31·7	1·7	6·1	4·7	13·3	3·3	10·8
May (up to 13th)	14·4	9·4	27·8	31·7	1·9	6·1	3·3	12·8	2·5	10·6

On the 14th May germination tests were started in the usual manner, i.e. seeds were counted into lots of 100 each and sown on damp filter paper in petri dishes. The seed which had been subjected to the more extreme temperatures in Cape Town gave results comparable with those given by seeds which had received similar treatment in the years 1928 and 1929 (see Table 1, 2nd column). In corresponding manner, the seed which had been subjected to the more equable temperatures of Rondebosch gave results agreeing with those obtained in 1930 and 1931. There can therefore be little doubt that some temperature factor is

operative in facilitating the process of after-ripening. At present it is impossible to say what the precise nature of the factor is. The fact that a veld fire promotes germination suggests that high temperatures rather than low ones are of importance. It may well be that within the limits of ordinary room temperatures great daily fluctuations are of more importance than the absolute maximum experienced, but further experiments are needed.

TABLE 3.—Germination Tests. 100 Seeds sown in each Petri Dish.

Date on which test was started.	Stored in Rondebosch.	Stored in Cape Town.
14th May	51	57
	33	54
	25	67
	48	43
	Total 157 Average 39·25%	Total 221 Average 55·25%
27th May	62	72
	68	76
	63	72
	69	83
	Total 262 Average 65·5%	Total 303 Average 75·75%
14th June	77	90
	76	82
	75	87
	74	82
	Total 302 Average 75·5%	Total 341 Average 85·25%

In previous years only one series of tests was made and these were always carried out at the same time of year, starting in the middle of May, the time at which the rhenoster seed ripens on the plant. In 1932 however, it was considered desirable to get larger numbers and further tests were made, a second lot being started on May 27th and a third on June 14th. Since the middle of May all seeds had been kept at Rondebosch. The figures obtained in these later tests are given in Table 3, and although the same difference may be observed between the seed stored in Cape Town and that kept in Rondebosch, the difference is by no means as sharp. In both tests the number of germinations in

each petri dish is far higher than in the earlier test. In fact these numbers are far higher than any obtained before. Reference to Table 1, which sums up the results of tests made with several thousands of seeds, reveals the fact that 69% is the highest figure previously recorded. What meaning is to be attached to these results is obscure. The temperature records which were kept while the tests were in progress show nothing to explain the results.

The results just recorded are obviously in need of explanation but they must not be allowed to obscure the fact now established that the dry seed of the rhenoster bush is susceptible to the influence of temperature during its resting period.

Up to the present our knowledge of dormancy in seeds has been derived largely from experimental studies on plants inhabiting cold temperate climates. Crocker (1) and many other writers have pointed out that seeds which fail to germinate when placed under suitable conditions may fail to do so for one or more of several reasons. The embryo may be immature and in these cases a series of changes termed after-ripening must take place before germination is possible. In other cases the cause of failure to germinate lies in the seed coat which may enforce dormancy by preventing water absorption, by inhibiting gas exchange or by preventing expansion of the embryo.

In the rhenoster seed the cause of dormancy almost certainly lies in the embryo and not in the pericarp. Fresh seed when sown absorbs water just as rapidly as that which has matured. Removal of the pericarp in fresh fruits is a difficult operation as in addition to their minute size the embryos are extremely soft and lack the firmness of texture which characterises them when mature. Attempts to remove the pericarp at this stage have usually resulted in injury to the embryo, and moulds have destroyed the few uninjured embryos that were obtained. Thus it is impossible to say if the pericarp plays any part in the phenomenon of dormancy in the rhenoster seed. However, the change from the soft, somewhat amorphous embryo of the first year seed to the firm, sharply differentiated one of older seed, renders it probable that the cause of dormancy lies in the embryo itself.

Several workers have made a study of seeds showing dormancy due to the necessity for after-ripening processes in embryo, endosperm or both. Davis and Rose (2) have shown that in the seed of the hawthorn (*Crataegus mollis*) the process of after-ripening is favoured by low temperatures in the neighbourhood of 5° C. Similar results have been obtained by Rose (8) for *Tilia americana* and Pack (7) for several species of *Juniperus*. In all these cases the process of after-ripening takes place while the seeds are fully supplied with water. Few cases have been

recorded where changes of this nature have occurred with the seed in an air-dry condition. Gassner (3) has reported such an instance in the case of the seeds of certain South American grasses where dry storage at a temperature in the neighbourhood of 55° C. caused a marked increase in germinating capacity. The interest of the present case lies in the fact that it has been possible to demonstrate a change in germinating capacity in seeds stored at different room temperatures. At Rondebosch these temperatures ranged from 10·3° C. to 28·3° C., while for the same period in Cape Town the figures ranged from 5° C. to 36·7° C.

A feature of the rhenoster seed which is probably of considerable benefit to it under natural conditions is the protracted period during which seeds will continue to germinate. Seeds start germinating a little over a week after sowing and the majority germinate within fifteen days, but odd seedlings continue to appear for several weeks. It has been shown in an earlier publication (4) that young seedlings are most susceptible to drought even of a temporary nature, and the protracted period of germination will ensure the survival of at any rate some of any given sowing.

ANTHOSPERMUM AETHIOPICUM.

This bush is frequently associated with the rhenoster bush in areas where a moderately high rainfall is experienced, but apart from this association it has little in common with the rhenoster bush. Many farmers consider it a valuable plant indicator. Soils on which it grows abundantly are regarded as being suitable for the cultivation of deciduous fruits. While seedlings of the rhenoster bush are stimulated by a veld fire, the seedlings of this plant occur in equal numbers on burnt and unburnt areas.

Fruit is produced in great abundance during the early summer months, and is frequently retained on the parent plant until the winter. Each mericarp is between 2 and 3 mm. in length, is somewhat bulky and possesses no special facilities for bringing about distribution. In this respect it is in marked contrast with the rhenoster bush, the fruits of which are admirably adapted for wind dispersal.

Most of the fruits contain viable seed and the germinating capacity is high. The method adopted here was the same as that employed in the case of the rhenoster seed, viz. three or more petri dishes with 100 seeds on moistened filter paper in each, were established each year. The seed used in these experiments was collected at Stellenbosch in December 1926 and sown for the first time in May 1927. In the four subsequent years similar sowings were made in the same month. For the first four years an average germination of between 80% and 90%

was maintained, but in the fifth year it dropped to 69%, showing that a process of deterioration had begun.

The accompanying graph illustrates the changes in germinating capacity of the seed in relation to age. In order not to complicate presentation, curves for the years 1927, 1929 and 1931 have been given, the intermediate years being omitted. These curves show that in fresh seed germination starts early, rapidly attains a maximum and then falls off sharply, ending on the 12th day after sowing. Two years later the maximum period occurs slightly later, and seeds continue to germinate until the 18th day. In seeds four years old the maximum period is much later and is less well defined. The whole germinating period is much more protracted, continuing till the 39th day.

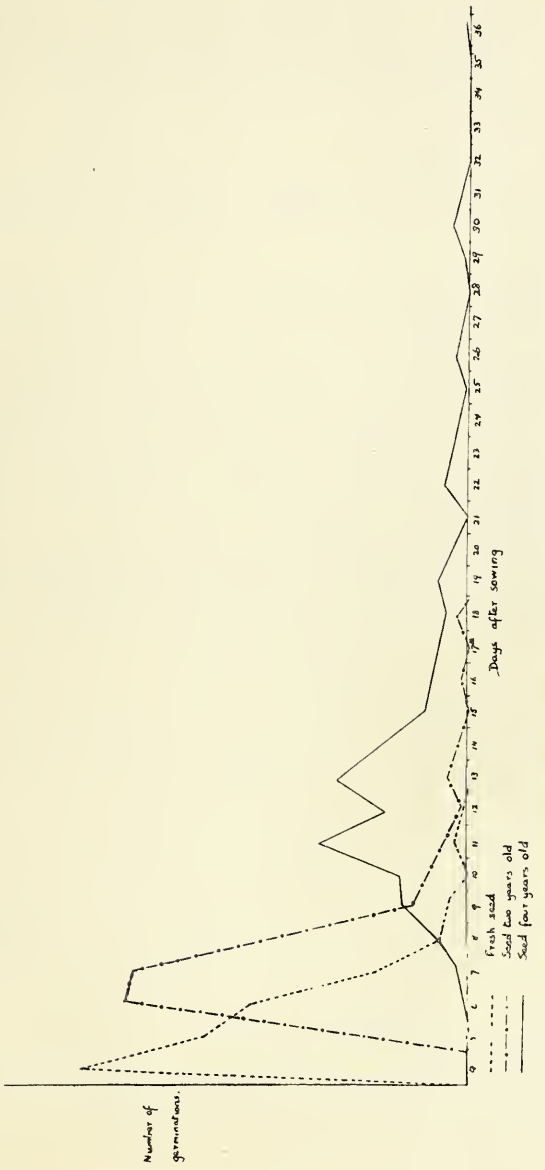
Relhania genistaefolia.

This plant is frequently found in association with the rhenoster bush, and a special feature is its dimorphic fruits. Those of the disc florets are smooth, circular in transverse section and crowned with a pappus of small, acute scales. Those of the ray florets are covered with stiffish white hairs, and are triangular in transverse section. The pappus is the same as in the disc florets. Neither fruit is adapted for wind distribution but animals may well assist in the case of the ray fruits. Fruits are formed during November and December and are shed at once.

Tests carried out in petri dishes showed that the fresh seed had an average of 72% of germination for fruits of the ray florets and 17% for fruits of the disc florets. Some of the seed was kept for a year and then tested once more. The figures were then slightly higher, being 78% for the ray fruits and 21% for the disc fruits. The general type of germination is similar to that of *Anthospermum aethiopicum*. Germination starts about the fifth day and reaches its maximum at an early stage. The duration of the period is from 14 to 20 days.

The writer wishes to take this opportunity of thanking Miss S. Garabedian for her co-operation. During the period from August to May, while some of the seeds were being stored in the Herbarium of the South African Museum, Miss Garabedian kept a record of the maximum and minimum temperatures for each day. These records form an integral part of this paper.

The writer also wishes to acknowledge her indebtedness to the Research Grant Board of the Union of South Africa for a grant in connection with this research.



Anthospermum aethiopicum. Changes in germinating capacity of seed in relation to age.

Summary.

1. The germinating capacity of the seeds of the three following plants have been studied: *Elytropappus rhinocerotis* (the rhenoster bush), *Anthospermum aethiopicum* and *Relhania genistaefolia*.

2. The seed of the rhenoster bush is much stimulated by veld fires under natural conditions.

3. Fresh seed of this plant has a very low germinating capacity, but if stored dry will give a much higher percentage of germinations the next year and this enhanced capacity for germination is maintained for several years.

4. Reasons are given for regarding this increase in germinating capacity as being due to after-ripening processes in the embryo.

5. Temperature operating while the seeds are in an air-dry condition, is shown to play an important part in these after-ripening processes.

6. The stimulus of fire has no effect on the seeds of *Anthospermum aethiopicum*. No after-ripening is necessary in these seeds, germination normally taking place a few months after the fruits are produced. The germinating capacity is high. In seed that is not more than four years old germination takes place rapidly. After the fourth year of storage signs of deterioration are apparent.

7. *Relhania genistaefolia* has dimorphic fruits. Those produced by the ray florets have a much higher capacity for germination than those of the disc florets. No period of after-ripening is necessary.

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STOEBE SP.

A CONTRIBUTION TO ITS ECOLOGY.

By C. Cohen.

This study has been considered as a matter of considerable importance in the grassland studies being carried out at the Botanical Research Station, Frankenwald, under the direction of Prof. John Phillips, University of the Witwatersrand. It is quite largely an investigation into the physiological-ecology of a grass community; this is also true, ultimately, of those parts of the investigation, which at first sight lack this direct connection.

Communities of this Stoebe* cover a considerable area, in the aggregate, in the Transvaal, and being a woody shrub, dry, and even prickly except for a few months in the year, its general unpalatibility allows it to occupy ground, which would otherwise carry a certain amount of grazing. The shrub grows to a height of about two and a half feet, and, taking into consideration the area covered by all the side branches, it may have a diameter of six feet. In appearance it is ericoid, and apparently xerophytic.

In a consideration of the annual life cycle of this plant, it is as well to start at the time of seeding and germination, which constitute critical points. With regard to seeding, it appears from combined field observation and laboratory experiments, that the seeds require a high water content in the soil, for germination. Thus young seedlings will be found only after good rainy seasons. The most favourable water content for germination would be in the neighbourhood of 90% of the Maximum Water Retaining Capacity, that is, 27% of the oven dry weight. It must be added that this high figure was determined in a series, which was not very exact, but sufficiently so, to show the trend of the experiment. At the same time, it appears that seeds have no opportunity to germinate on even moderately covered ground; hence young seedlings generally are found on such relatively open areas as old roads or fire-breaks. This may be the result of the operation of the necessity for this high water content.

The seed crop is very heavy. Germination of seeds a year old gave a rough average of 40% viability. Generally, the first germinations occurred in ten days. In one case, germination did not cease until the 64th day, among a set of seeds on a germinating dish. Germinative

* According to Mrs. M. R. Levyns (manuscript), probably a new species, allied to *S. cinerea* Thunb. The vernacular names are "Slangbos" or "Grijsbos."

capacity is destroyed by fire, and by heating in water to 75° C., while even heating in water to 50° C., lowered the germination to 15½%. Germination in the dark, with a comparatively small number of seeds gave a return of 47½%, but none of the seedlings, when potted, lived. Seeds planted in a pot, and watered from below, resulted in the growth of 22½% of the sowing; but with a much higher water content, about 37½% of the seeds have already got past the cotyledon stage. It was found possible to separate highly viable seeds from those not quite so highly viable, by leaving them in water. A selection of those that had sunk to the bottom of the dish gave a germination of 70%, while those that had remained on top, showed only 20%. After three days' soaking, however, the seeds which in the meantime had sunk to the bottom gave 52%, and while comparatively few remained on top, they showed a still lower figure—26½%. The conclusions that may be drawn from these observations is that the plant is spread by seed.

Very young seedlings have not been found in the field, but apparently this is so because they are not distinct or noticeable until they are about six months old. At the end of the year, the plant bears a single head of flowers, or perhaps three at the most. The anatomical aspect of growth presents some remarkable features, with regard to the formation of cambium. It seems that fresh rings of cambium are being formed continually. It appears that the plant becomes rapidly woody. Again, the holard exercises a marked influence on the growth increment. A sort of root-stock is present, and it is probable that it is used as a storage organ. The precise time of growth is uncertain, but it is probably during favourable periods between November and March, when the bushes are fresh and green. Seeds are ripe between April-May-June, depending on the season. After this the shrubs become dormant to some extent and turn greyish in colour, the leaves losing their temporary freshness.

Water content of Stoebe twigs ranges from 22-69% on fresh weight, and 28-224% on oven dry weight. A few figures from the period early May to early June, this year, show the water content, in relation to the ash, may vary, taking the ash weight as 1, from 13·5 to 42·5. Similarly, the dry weight may vary, with regard to the weight of ash, between 18·5 and 31·5, depending in both cases, on rains, which raise the soil water, then the water content of the plant, and then the ash weight, at which time the dry weight falls. After this period, the dry weight increases, and the other factors decrease, though not necessarily in proportion: that is, the ash, for instance, will still remain high.

Up till now it has not been possible to make a very accurate determination of transpiration, but it has been roughly determined by

oil potometer, against "Blackwood" (*Acacia melanoxylon* R.Br.). for comparison. It is very high. For this reason, holards under Stoebe communities are deceptive, especially when they are only at moderate depths, and taken as isolated examples. The high water loss is very distinct in its effects as seen after burning, when a distinct bare area is visible round each big bush.

A root-bisect has shown Stoebe going down five feet. This probably is due to the loose sandy nature of the soil, which in the first place, permitted of such growth ; and in the second place, was probably necessary because the water did not remain in the upper levels. On the other hand, Stoebe has been found growing on "Ouklip", (Iron sesquioxide), with roots at about a depth of two feet below the surface, and many laterals. It might be noted that large plants, on being removed from the site of growth in the moist and cool month of December, 1933, wilted perceptibly, and would not grow after being transplanted. Further, it must be added that Stoebe plants have been found growing on soils which contained a large amount of clay, and showed M.W.R.C.'s 50-77%, but that this particular site was well watered by natural drainage. A comparison of roots among a few of the co-dominants of Stoebe, as they are found on Frankenwald, show *Eragrostis chalcantha*, with nearly all its roots in the first 6-12 inches ; *Elionurus argenteus*, with about half in the first foot, about half extending towards 18 inches, and a few almost to 2 feet ; *Tristachya hispida*, less important, mostly in six inches, and a few to 1½ feet. In the first place, as noted already, Stoebe is seasonal and rhythmic, but, unlike its competitors, it does not flower till late, about April, whereas the grasses mentioned above flower in late November-December. Some grasses, like *Cymbopogon plurinodis*, flower about April. In Cymbopogon, the roots are mostly laterals, at depths of 1-2 feet. It must be mentioned that only one example of each of the above is available, so that they may not be typical. This work seems to suggest that the co-dominants, with their rather shallow rooting, receive the benefit of the first rain, and thus grow and flower, and that it is only much later in the season—when the pressure of competition has eased—that Stoebe is able to perform these functions. These facts also suggest that any agency tending to interfere with, or even remove the grasses, would give Stoebe an easier existence, and further, that if no such interference does take place, the further growth of the grass cover may eventually react unfavourably on the bush.

It may be noted, that in testing grass seeds, germination was low, 6-7% for *Elionurus argenteus*, and about 25% for *Eragrostis chalcantha*. These figures are not worth much, as only a small number of seeds could be tested, and a number of tests proved negative. Nevertheless, the

indications are that germinative capacity in this type of grass is not high.

As the bush regenerates from seed, clearing has been found very successful. Firing, on the other hand, only stimulates the buds, which are situated on the stock, and at the base of each main stem. At no time of the year is firing successful. Furthermore it must be noted that it is not merely veld fires which are referred to here, but "burning-back" when dried grass and wood are piled round each bush, after the preliminary fire; even this extra heat does not kill the dormant buds, except in a small percentage of cases.

Poisoning has also been tried out, as a method of eradication. Arsenic pentoxide, potassium chlorate, and sodium chlorate have been tried. Sodium chlorate is the most successful, and the most easily handled. Solutions of various strengths, from $2\frac{1}{2}$-10% have been tried. Either the foliage was sprayed, or the butt of the plant. Both methods were equally successful. A gallon of the solution—in all strengths—was used for every fifteen plants. Whether or not the effect is permanent yet remains to be seen.

It is not possible, at the moment, to say very much about the typical physical conditions which form the environment of this plant, if there are any typical physical factors. This is not so much as regards the climatic features, but the edaphic, which are more liable to be modified, and more directly modified by the plant. A preliminary investigation suggests that the soil would be of a type which definitely is impoverished, and that this would be so, because it has been overgrazed. Detailed reconnaissance shows a record of occurrence for Stoebe, twice as great on grazed areas, as on ungrazed. By "grazed" is meant fairly heavy, and rather permanent stocking Annual firing for instance, will not bring in the plant and this is apparently so even when the firing is continued over a long period. This may be because seeds are destroyed, but probably not, considering the time of firing. Overgrazing, on the other hand, does lead to the appearance of Stoebe, probably because definite denudation takes place, after the plants in existence have been roughly handled. Water content does not appear to be important at this point, except as regards germination. That is to say, a soil where Stoebe is not existent will show much the same holard as a soil where Stoebe is quite heavy, and this may be so for different rock formations within a short distance of each other. On a soil which is naturally rather rich, over-grazing may not tend to denude the ground of vegetation, as happens on a poor quartz soil. Probably the soil under a Stoebe community will be rather acid, because the soil is of a type that permitted leaching, and leaching is probably a bigger factor than the presence

or absence merely of carbonates or lime. All the possible factors, M.W.R.C. values, pH values, holards, carbonates and the physical structure of the soil are so intimately related, that it is difficult to separate them. A few tests have shown absence of nitrates and of ammonium salts from both Stoebe and non-Stoebe soils, but the organic matter is rather higher in the latter than in the former. The bacterial population does not appear to be very great in either of the two types of soil, though it may be considered slightly greater in non-Stoebe soils, which, while showing pH values of from 6·67-7·06 are more suited to bacterial growth than the Stoebe soils, which ranged from 5·12-5·56.

In conclusion, I wish to acknowledge, and to thank Prof. J. F. V. Phillips, for his constant supervision of the whole of this investigation ; Dr. E. M. Young, for her generous assistance with the anatomical work (which is yet unfinished), and many other points in this work ; Dr. B. Segal, for determination of the pH values mentioned above, and also assistance and advice ; Mr. T. Barenbrug for his method of germination of the seeds ; Mr. Murray and Mr. Glover, for the use of their records, some of which are not yet published.

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REVIEWS AND ABSTRACTS.

JAMES, W. O. and CLAPHAM, A. R. The Biology of Flowers. Oxford University Press, 1935. Publ. at 8s. 6d. net. pp. viii and 115. 71 illustrations.

This is a book that will fill a decided gap in modern botanical literature. While in the text books of the first half of the nineteenth century, the flower and its structure occupied most of the space devoted to the higher plants, there has been since a tendency to emphasise lower plants and the physiological aspects almost to the exclusion of all else.

In many elementary courses the flower is treated from the standpoint of a classification which cannot be appreciated from an examination of a limited number of types and its importance as a reproductive structure lost sight of. One result is that the study of flowers often appears as a curious puzzle in permutations and combinations which is interesting neither to teacher nor pupil. The commonly followed methods have, moreover, resulted in a stereotyped method of procedure and description which is reproduced unchanged from one generation of students to the next.

If for no other purpose than to improve and correct this attitude, this volume should be generally welcomed as bringing a more true understanding of the flower and its functions.

The book commences with a description of the flower and its various parts, considered throughout as constituting a more or less efficient mechanism for reproduction. The descriptions are all based on studies possible by dissection and the use of a hand lens. Microscopic details are sedulously avoided. The technical terms used are carefully defined and when first introduced are printed in heavier type. There has been a judicious selection and unnecessary terms are avoided. An explanatory glossary is also given at the end of the book.

The descriptions of structure are correlated with a study of the development as it can be traced without recourse to the microscope. The stress that is laid on development is a point much to be commended. If buds were more often examined along with, and in explanation of, the fully formed flower much of the ordinary attitude of regarding structure as part of a jigsaw puzzle of nature, might be combated and removed.

A rather full chapter on pollination follows in which are included notes on some types of insect visitors and their structure and habits. The desirability of cross-pollination and the means by which it is attained are well set out. Indeed the whole of this part provides an interesting and well balanced account of a subject so often treated either wholly teleologically or merely as a series of disconnected instances. It is perhaps unfortunate that no mention is made of the experimental work on pollination carried out in America.

A descriptive account of the fruit, seed, and embryo follow.

The second portion of the volume, pp. 40-113, is devoted to descriptions of individual types of flower of which there are 29. These types are arranged according to the methods of pollination. The examples are selected from the British flora and as such most will be unfamiliar to the South African

reader, but they can well serve as excellent models on which to base a similar study of our own most interesting flowers.

A most prominent feature of the book is the excellence of the illustrations nearly all of which are of full page size. All of them are of a kind to be taken as models for both teacher and pupil. Some of the drawings are taken from Church's well known though rather rare book, but many are original.

The book is one well worth study and one that should do much to enhance one of the most fascinating sides of botanical study.

Goosens, A. P. and Theron, J. J. An Anatomical Study of *Themeda triandra* Forsk. (Rooigras). S. Afr. Journ. Sci. XXXI. 254. 1934.

Themeda triandra is the most important pasture grass in South Africa. In this paper the anatomy of the root, stem, and leaf is described in some detail. No very striking or unexpected features of structure are recorded. The authors demonstrate that it is possible to distinguish a number of varieties by utilising a combination of external features and anatomical characters, more especially those of the epidermal cells of the leaf. Eight varieties are recognised and a key is given for their identification.

Goossens, A. P. Notes on the Anatomy of Grass Roots. Trans. Roy. Soc. S. Afr. XXIII, 1. 1935.

The anatomical structure of the roots of a number of the commoner grasses of the High Veld are described.

In its young stages the cells of the surface of the root and the root hairs become mucilaginous. The mucilage becomes clogged with soil particles and often forms a persistent sheath round the root which is protective.

The endodermis round the stele has no passage cells and forms an impermeable isolating sheath.

The character of the cortex in the root varies according to the moisture, temperature, and oxygen content, of the soil.

Young, E. M. Note on the Occurrence of a Series of Bisporangiate Cones in *Pinus insignis*, Douglas (*P. radiata* Don). S. Afr. Journ. Sci. XXXI. 1934.

Trees found at Witpoortje showed branches which had terminal female cones with a number of smaller cones below. The lowest of these small cones were staminate, the upper ones intermediate and bisporangiate.

The correct name for the tree is *Pinus radiata* Don. The commonly used name, *P. insignis*, is invalid, and should be dropped.

Rimington, C. *Psilocaulon absimile* N.E.Br. as a Stock Poison. S. Afr. Journ. Sci. XXXI., 184. 1934.

Psilocaulon absimile is a succulent not uncommon in parts of the Karroo and is poisonous to stock.

An alkaloid, piperidine, has been found in it, and is regarded as responsible for the symptoms shown by animals.

Piperidine occurs in the plant as the hydrochloride. This alkaloid has not before been found in plants as such but only in combination. *Psilo-*

caulon is suggested as a possible source of supply for the substance which is at the present time very expensive.

Levyns, M. R. Notes on Nomenclature in some Members of Compositae. Trans. Roy. Soc. S. Afr. XXIII., 91. 1935.

A number of alterations in names are shown to be necessary.

Stoebe tortilis DC is *Disparago ericoides* Gaertn.

St. cinerea Thunb. must be restricted to the shelter-loving plant of the Cape Peninsula.

St. plumosa Thunb. is the name for the plant called *St. cinerea* in Fl. Cap. and elsewhere.

Elytropappus scaber Levyns is the name for what has often been called *E. glandulosus.*

The real *E. glandulosus* Less. is a local species collected in few localities and not recently.

E. gnaphaloides Levyns is applied to cover the plants variously known as *E. canescens* DC, *E. ambiguus* DC, and others.

(See also Levyns, A Revision of *Elytropappus.* Journ. S.A. Botany, I., p. 89. 1935.)

Taylor, G. Notes on Labiatae II. The Genus *Acrotome,* Benth. Journ. Bot. LXXIII., 1. 1935.

A revision of the genus with descriptions of two new species, one of which is from South Africa. In all eight species are recognised, five of which occur within the Union. A key to these species is given. The new species are *A. angustifolia* which is known from the Transvaal, Bechuanaland, and Northern Rhodesia, and *A. mozambiquensis* from Portuguese East Africa. The genus is entirely confined to the southern parts of Africa.

Lloyd, F. E. *Utricularia Rendlei*: a new species from Victoria Falls. Journ. Bot. LXXIII., 40. 1935.

The species was collected on the occasion of the visit of the British Association for the Advancement of Science to the Falls in 1929. The new species is described and figured and the points of difference between it and the closely allied *U. subulata,* L. from America are tabulated.

Baker, E. G. New Genus of Leguminosae from Northern Rhodesia. Journ. Bot. LXXIII., 160. 1935.

The new genus *Gamwellia* contains one species, *G. flava,* found in the Abercorn district. *Gamwellia* is allied to *Lotononis* but has diadelphous stamens and leaf-like stipules. The plant is figured.

Bremekamp. C. E. B. The Origin of the Flora of the Central Kalahari. Scientific Results of the Vernay-Lang Kalahari Expedition, March to September, 1930. Ann. Transv. Mus., XVI., III., 443. 1935.

This is a critical review and discussion of the present position of knowledge of the flora of the Kalahari, based on the results of the Vernay-Lang expedition along with previous work. The main conclusions may be summarised as follows:—

(1) The desert period has obliterated all traces of the original flora. The desert flora itself has no remnants except possibly a few halophytes. It is possible that *Welwitschia*, *Acanthosicyos*, and other plants in the Namib may be remnants of the desert flora.
(2) There is no botanical evidence to suggest a pluvial period following the desert one.
(3) The present flora has arrived from the north and north-east. Migration from the east has not been important.
(4) The country west and south of the Central Kalahari was populated by the plants arriving there early and driven out by the later and more aggressive forms.
(5) The Central Kalahari, with western Southern Rhodesia, and the north-western Transvaal, ought to form a separate sub-province of the East and South African savanna.

Bremekamp, C. E. B. and Obermeyer, A. A. Sertum Kalahariense : a list of the Plants collected. Scientific Results of the Vernay-Lang Kalahari Expedition, March to September, 1930. Ann. Transvaal Mus. XVI., III., 399. 1935.

This is a list of the identifications of the plants collected by the expedition. One new genus and 25 new species are described, and a number of new combinations are made. The new genus is *Neuradopsis*, which contains three species, two of them new, the third transferred from *Neurada*. The new species here are *N. grieloidea* and *N. bechuanensis*. The other new species are :— *Marsilia villosa*. *Lagerosiphon tsotsorogensis*, *Ottelia Vernayi*, *Tragus arenarius*, *Panicum bechuanense*, *Eragrostis Stentiae*, *E. Vansonii*, *Nerine gaberonensis*, *Nymphaea Vernayi*, *Cleome bechuanensis*, *C. sulphurea*, *Sesbania rostrata*. *Cardiospermum alatum*. *Hibiscus rivularis*. *Caralluma Vansonii*, *Heliotropium malodorum*, *Sesamum gibbosum*, *Cyphia bechuanensis*. *Lobelia* (*Metzleria*) *tsotsorogensis*, *Sphaeranthus kalahariensis*, *Pentzia laxa*, and *Berkheyopsis Langii*.

R. S. Adamson.

INDEX TO PLANT NAMES.

REVIEWS AND ABSTRACTS.